SCIENCE.

FRIDAY, NOVEMBER 9, 1883.

THE LICK TRUST.

It will be remembered that a certain portion of the large estate of Mr. Lick was to be devoted to the uses of science. A specific sum of seven hundred thousand dollars was to be expended in the purchase of the most powerful telescope attainable, and in the construction of an observatory on Mount Hamilton; and the unexpended balance of this sum was to constitute a permanent fund for the maintenance of the observatory. Many specific bequests were made for other purposes not scientific; and after all these specific sums had been paid, it was provided that the sum remaining over should be divided between the Society of pioneers of California and the California academy of sciences. Science is interested, also, in this last bequest. It will be remembered that many changes of trustees, and also of the form of the gift, were made in the early years of the trust; and that vexatious suits were entered by supposed heirs of Mr. Lick, which were successively decided by the courts. At present a definite construction of the deed of trust has been made by the supreme court of California, from which there is naturally no appeal; and the trustees are acting under this construction.

During the period of years over which the preliminary litigation extended, a great shrinkage in the values of real estate took place in California, as well as elsewhere in the United States. At the end of these litigations, the trustees found themselves in control of much valuable property, which could be sold only at a great loss. If it had been sold at that time, there would have been no money left to divide between the pioneers and the academy; and not only this, but some of the specific bequests would have remained unfulfilled: it was therefore the policy of the trustees to manage the estate carefully, and to sell only to advantage. In this way only, would the residuary legatees receive any considerable sum. The estate has certainly been well managed: for from Dec. 1, 1876, to Oct. 1, 1883, the aggregate net profits have been $453,458, or over $66,000 per year. There was no surplus to divide in 1876; while, at the present time, some $192,000 remains over, free of all specific bequests. It therefore would appear that the trustees have deserved well of science for their careful administration of the trust.

Their policy has clearly been wise, when looked at without prejudice: but it has not been acceptable to the residuary legatees, since they have not yet received any immediate benefit; nor can they, under the decision of the court, until the whole estate is settled, and all specific bequests are fulfilled.

This is no doubt annoying to the academy of sciences, which has so many useful purposes which could be served by an increased income. It is specially annoying to the pioneers, who all came to California in 1849–50, and who, therefore, are all men in middle life. When the French countess heard of the Montgolfiers' balloon ascension, she exclaimed that these men would certainly invent the art of never dying; but she added pensively, 'It will be when I am dead.' This is the very natural attitude of the pioneers; and it is this that has led to a recent savage attack on the trustees, reports of which have appeared in the San Francisco and other papers. These attacks have been directed against the whole action of the trustees, without discrimination. It is, however, clear, that the actions of the trustees must be considered in two ways. Most of their official acts have been done under specific directions of the courts of law. These acts are much complained of by the residuary legatees: but it is obvious that such complaints are idle; for, if the trustees had not obeyed the orders of the courts, they would

have been long since expelled from their responsible positions. The remaining acts complained of have been done in pursuance of the general policy just outlined. It seems equally clear that these complaints, though natural, are unjust. The residuary legatees have now $192,000 to divide. It is not long since they had nothing. Science is certainly grateful to the trustees, since their economical policy has already saved a large sum which will eventually go to making the California academy of sciences more powerful and useful than it now is.

With regard to the other bequest in which science is interested, — namely, the Lick observatory, — there is every reason to be extremely grateful to the trustees for their wise administration of the trust.

Their economy has certainly been remarkable. They have expended on the observatory to Oct. 1, 1883, $154,527.98; and they have remaining $545,472.02. This $155,000 has done the following things: the top of a bleak mountain four thousand feet above the sea, and twenty-seven miles from a town, has been levelled off so as to give a sufficient area for the buildings (forty thousand tons of rock have been removed for this purpose alone); brick enough to complete the whole of the buildings has been made on the side of the mountain, and delivered at the top, at a total cost less than the price of hauling the same amount from the nearest town; a handsome and well-built main building is now nearly finished (the large dome alone remains; a small dome, containing a very perfect twelve-inch equatorial by Clark, has been in use since November, 1881); a four-inch transit instrument, in a convenient house, is in complete working-order; a photoheliograph in a permanent house has been in use since December, 1882; the house for the meridian circle is begun; the meridian circle is half paid for, and a payment has been made on the large telescope. This is the work which is to be seen on the mountain-top proper. Just below this are the houses for the workmen, shops, stables, etc., all in good condition, and a very complete system of water-supply in full working-order.

It will appear to any competent person that this work has been done thoroughly, and that it has been done economically. At the same rate of expenditure, at least $300,000 will remain as a permanent fund for the support of the observatory.

It therefore appears that the trustees have deserved well of science in their administration of their trust, not only in regard to the California academy of sciences, but also in relation to the Lick observatory; and it should be the desire of all interested in the administration of this trust to strengthen the hands of the trustees in the continuance of their wise policy.

WHIRLWINDS, CYCLONES, AND TORNADOES.[1] — II.

The further growth of the desert-whirl may be briefly described. The air standing quietly on a flat, dry surface allows the lower strata to be quickly warmed to a high temperature. If the air were in motion, no part of it would remain long enough close to the ground to be greatly warmed; if the surface were not flat, the lower air would flow up the slopes as soon as it was a little heated, and not wait to acquire a high temperature; if the surface were wet, much of the sun's heat would be occupied in evaporating the water (as will be explained below), and would so be lost to the lower air: it is therefore only in calm weather, on a desert plain, that the sun can succeed in warming the lower air to excess, and so produce a very unstable equilibrium, and a strong up-draught when the upsetting begins. The longer the delay before the overturning, the more heat-energy is accumulated, and the more violent the motion when it begins. The lower air rises at some point against the oppression of the upper layers. The surrounding warm air flows in from all sides toward this central point, and follows the leader. Soon the motion becomes general and lively, dust and sand are blown along toward the centre, lifted and carried aloft with the ascending air in its rapidly rising current, and then the whirling column becomes visible. When thus established, the increased velocity and the rotary motion of the air near the centre are constant characteristics of the upsetting. Thirty

[1] Continued from No. 39.

or forty feet to one side, the wind may not be strong enough to brush along the sand, and a few hundred feet away it may not be perceptible; but at the centre it makes a distinct rushing or roaring sound, and carries light objects upwards, sometimes to a height of several thousand feet. This increase of velocity of the surface indraught toward the point of its upward escape is a general feature of the motion of a mass of free particles along a path of varying width: the narrower the path, the faster the motion. The same increase is seen in the growing velocity of a stream running out of a lake, so beautifully shown where the Rhone

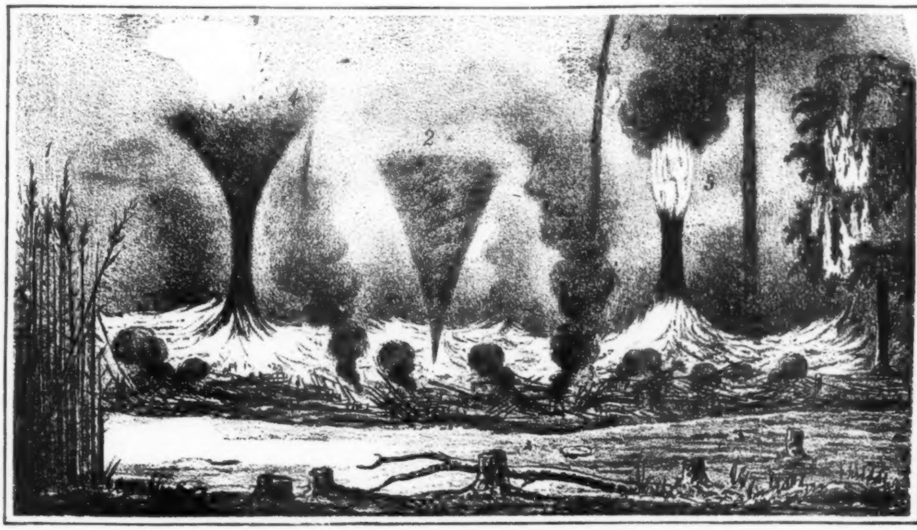


FIG. 3. (Taken from *Amer. journ. sc.*, 1851.)

flows from Lake Geneva, or, more simply and prosaically, in the running of water from a tub by the escape-pipe. In the case of a desert-whirl, the central wind is held by friction with the surface sands much below the velocity it might attain; for it must be remembered that these whirls are supplied by a comparatively thin layer of superheated air next to the ground, often not more than four or five feet thick. The restraint of friction on such a layer will be very considerable, and its motion can seldom reach a disastrous strength. It is probable that in the desert sand-storms, which are described as overwhelming caravans, there is a much thicker mass of air in activity, and the conditions of motion approach those of the tornado, as will be shown farther on.

The second characteristic feature of the wind's motion gives name to the storm. A whirl must necessarily be formed when the air moves inwards from all sides towards a centre, for the indraughts will surely fail to follow precisely radial lines. Their aim will be a little inexact; and, as they pass to one side or the other of the centre, a turning must begin in a direction determined by the strongest current. This, once begun, is maintained by the centrifugal force that arises from it; and the size of the central whirl will then depend on the balance between the centripetal and centrifugal forces. In ascending at the centre, the wind follows an upward spiral course, like the thread of a screw of steep pitch, with a diameter of five to twenty feet. The direction of turning is indifferently one way or the other, according to the side on which the indraught happens to pass the centre. The height to which the whirling column rises will be determined by its mixture with the adjoining air, and consequent cooling until its temperature is that of indifferent equilibrium; and at this elevation the current will turn and spread laterally to make room for that which follows. Such a whirl will continue as long as its cause lasts; that is, as long as it is supplied with warm air at the base.

Manifestly it must stop in the afternoon, as the sun's heat decreases; and it can never occur at night, for then the surface-air is, as a rule, cooler than that above, and the atmospheric equilibrium is correspondingly stable. Further, the whirl will remain at one place, unless, as is often the case, it is carried along by a general motion of the upper air.

There is a very strong point of evidence, if any is needed, in favor of the view that heat applied to the lower layers of the air will produce a whirlwind. This is the fact of their production over fires. Much interest was excited in this question in connection with the artificial causing of rain, some forty years ago, in this country; and observations were carefully made of the whirls formed over burning woods and canebrakes, showing them to be very similar in form and action to those naturally arising on dry plains (fig. 3). Similar whirls have been seen over volcanoes (fig. 4); and on a calm day the smoke ascending from a factory chimney may be seen to have a slow rotary motion. Heat is therefore an amply sufficient cause of such disturbances. No other excitement is needed, and electricity has no essential part to play. In recognizing this, we see the chief difference between the older and newer theories of storms.

FIG. 4. (Taken from *Abhandl. gesellsch. wiss. Gött.*)

Sand-whirls are common in all desert or dry regions, where they often have the name of spirits or devils, from the fantastic and apparently evil way in which they flit across the burning sands. They have neither clouds nor rain. When well and frequently developed, they may grow to dangerous strength, and lift much dust and sand into the upper air, where it is blown long distances before falling. In this way they serve as important geologic agents. Vessels west of the Sahara, or east of China, are thus often powdered over with fine dust slowly settling down after a long flight from its desert source.

The smaller water-spouts, doubtless, belong near here in our scheme of classification; but as they are usually aided by vapor-force, and approach the character of tornadoes, their consideration is best deferred till later.

Finally, before going on to the larger storms, one point of much importance must be emphasized. The change from the stable equilibrium of night and early morning to the unstable of noon is effected entirely by the sun's heat, which warms the lower air, and causes it to expand. In expanding, it lifts all the upper air that rests on it; and this is no small piece of work, for the air that is lifted weighs about a ton over every square foot. When a point of escape is found, the heavy upper air sinks again, as the expanded air is drained off (upwards) at the centre. It is this gravitative force of the sinking air-mass that causes the dust-whirlwind, in re-arranging the disturbed equilibrium of the atmosphere; but gravity would have no chance to show its strength, if the air had not been lifted by force from the sun. The winds of a dust-storm, therefore, depend on gravitative force brought into play by the sun's heat. All storms and all winds have more or less closely this relation to solar energy and terrestrial gravity.

(To be continued.)

THE INTERNATIONAL FISHERIES EXHIBITION.—FOURTH PAPER.

ON the 1st of October, at noon, the number of visitors to the exhibition passed the much desired limit of two millions; and, although the rainy season had set in, the daily average of attendance was still increasing. The financial success of the enterprise was more than certain two months ago; and the receipts of each day since have been swelling the surplus fund, the disposal of which is now a fruitful subject of discussion in England. Although the organization is a private one, the character

of the men in control of it, and the recognition granted by the Queen and the Prince of Wales, render it certain that the profits will be devoted to some public enterprise. In the midst of multifarious minor propositions, two plans are receiving serious support. One of these is that first brought forward by Professor Ray Lankester, in his address upon 'The (possible) scientific results of the exhibition,' and relates to the establishment of a laboratory of marine zoölogy in Great Britain, for the joint advantage of fisheries and science. Professor Lankester's original memorial was signed by sixteen leading men of science, and has since had the indorsement of the British association. The rival scheme relates to the establishment of an orphanage for fishermen's children; and this, as may be imagined, is much more popular among the people and their newspaper exponents. One influential trade-journal expresses itself in energetic fashion in a paragraph which I cannot refrain from quoting, since it shows how little the opinion of a large class of Englishmen has been acted upon by the leaven of scientific thought. Speaking of the meeting of the British association, the editorial proceeds: —

"The conductors of the daily prints, always very amiable to the promoters of these useless gatherings, fool the *savants* to the top of their bent by reporting the 'papers' and discussions at an absurd length, thus making the credulous 'scientists' believe that the public takes a lively interest in their proceedings. . . . It is [the president's] grim task to write an 'address' usually so wildly mystifying as to drive his hearers and readers to the verge of idiocy. By common consent, this year's presidential address was not only more bewildering than any previously delivered, but absolutely incomprehensible; and it is charitably hoped that the Southport meeting is the beginning of the end. But these dreamy gentlemen are sufficiently wide awake to their own interests. . . . This they are, of course, entitled to do; and, if they can squeeze any money out of the public or out of the government, to aid them in the pursuit of their 'fads,' we shall have nothing to say. When, however, they go to the length of proposing to get a portion of the fisheries exhibition surplus into their hands for the purpose of establishing 'a marine zoölogical station on the English coast,' we take leave to denounce such a proceeding as both audacious and preposterous," etc.

In the mean time the executive committee makes no promises, except in the proposition to expend the sum necessary to bring over a Cape-Ann schooner, with a selected crew of fishermen, to demonstrate the American methods of fishing with purse seine, deep-sea trawl-lines, and dories, on those parts of the British coasts in which their use may be practicable. If any precedent is required for devoting a part of the proceeds to scientific ends, they have only to look to the Edinburgh exhibition of 1882, the surplus of which to the amount of nearly eight thousand dollars has been given to establish a marine laboratory near Edinburgh, under the direction of Mr. John Murray of the Challenger, and others. It is to be hoped that the demands of science will be remembered. Charities of all descriptions flourish luxuriantly in England, but the workers in science seem to feel that their needs are often seriously neglected.

The amount of the surplus is variously estimated at from forty thousand to a hundred and fifty thousand dollars. The management is not satisfied with the present success, however, and has leased the grounds for three years more from the commissioners of the exhibition of 1851, who, it will be remembered, bought with the surplus of that great enterprise those tracts of land now so valuable, on which all the museums and schools of science and art in South Kensington are now placed. Three great international exhibitions, similar in plan to the fisheries exhibition, are to follow, year by year; and by the end of 1886 the buildings will have more than paid for themselves, and a substantial sum will have accumulated, to be used, perhaps, in continuing the exhibition and museum movement which England has found to be so valuable to its intellectual and industrial welfare. The character of these exhibitions has not yet been determined upon. That of 1884 would doubtless have been devoted to horticulture, floriculture, and forestry, had not Scotland pre-occupied the field with a similar undertaking, and already secured the patronage of royalty. Edinburgh will therefore have its 'international exhibition of objects relating to practical and scientific forestry and forest products' next year; and London will follow in 1885 with a forestry exhibition, which cannot fail to be of world-wide importance. The London fisheries exhibition of 1883 gained much through the experiences of similar exhibitions in Norwich in 1881, and Edinburgh in 1882. The subject of the London exhibition of 1884 is not announced, but it is very possible that it will have to do with food-products. Another programme, hinted at by the Prince of Wales in his speech at the close of the exhibition, provides for a hygienic exhibition in 1884, one of the progress of invention in 1885, and in 1886 an exhibition of colonial products.

The literature of the exhibition is one of its most important features. Almost every subject connected with marine zoölogy and the technology of fishing has been discussed in at

AMERICAN SECTION OF THE INTERNATIONAL FISHERIES EXHIBITION IN LONDON.

least one special essay. The papers published by several foreign governments have been of great importance, particularly the treatises by Grimm, upon the fishes and fisheries of Russia, and by Apostolides, upon those of Greece. Those issued officially by the exhibition have been numerous, and, if the truth must be told, by no means of equal merit. None, however, are without value; and several, especially those by Huxley, Levi, Hubrecht, Lankester, and Day, are important contributions to science.

The official catalogue, edited by Mr. A. J. R. Trendell of the South Kensington museum, well known in America as the secretary of the British commission to our exhibition in 1876 at Philadelphia, is in itself a contribution to knowledge, and a model for the guidance of future exhibition administrations. Each section is introduced by an essay by some recognized authority, and signed. Much serious work has been done by the English periodicals in recording the teachings of the exhibition. *Nature*, under the head of 'Zoölogy at the fisheries exhibition,' has had a review of the vertebrates by Professor Giglioli, and of the invertebrates by Professor Ray Lankester; also a paper on the present state of fish-culture as illustrated at the exhibition, by Mr. Earll. The birds have been considered by Mr. Howard Saunders in the *Ibis*, and by Mr. J. E. Harting in the *Zoölogist*. Mr. Gwynn Jeffreys described the molluscan collections in the *Annals and magazine of natural history*. Mr. Dunell, Mr. W. B. Tegetmeier, Mr. Senior, and others have reviewed the technological features in the *Field*, and Mr. Fell Woods, the oyster-collections in *Land and water;* while *Engineering* has had an elaborate series of illustrated papers upon the vessels and scientific instruments, devoting several numbers to describing the U. S. steamer Albatross and its equipment, and to American devices for the exploration of the depths of the sea.

An official review, elaborately illustrated, of the exhibition and its teachings, is being prepared for the British government by Hon. Spencer Walpole, governor of the Isle of Man, well known as the colleague of Huxley and Buckland in the various fishery commissions from time to time instituted by Parliament.

Nearly every European government has sent hither specialists to report upon special subjects. Among the most eminent of these men of science have been Dr. Steindachner of Vienna, Dr. Sauvage of Paris, Dr. Möbius of Kiel, Professor Benecke of Königsberg, Professor Hubrecht and Dr. Van Bemmelen of Utrecht, Professor Giglioli of Florence, Dr. von Grimm of St. Petersburg, Dr. Malmgren of Finland, Professor Torell of Stockholm, Dr. Buch of Christiania, Mr. E. P. Ramsay of Sydney, Capt. Comerma of the Spanish navy, and Col. Sola of Madrid. The reports yet to be published will perhaps swell the literature of the exhibition to double its present bulk, and will be of interest to investigators in every department.

The exhibition was formally closed on the 31st of October by the Prince of Wales, who in his speech upon this occasion made certain very fitting allusions to the work of his father, Prince Albert, in the promotion of international exhibitions. G. BROWN GOODE.

A FOUR-DAYS' CRUISE OF THE ALBATROSS.[1]

WE left Wood's Holl at 4.10 P.M., Sept. 29, for an offshore dredging-trip. The weather was clear and pleasant, with light southerly winds and smooth sea.

At 9.02 A.M. the following day, we sounded in 1,342 fathoms, — bottom, globigerina ooze; latitude 39° 29′ north, longitude 70° 58′ 40″ west, — and at 9.38 put over the beam-trawl, veering to 1,900 fathoms of rope. It was up again at 1.03 P.M., the net containing a large number of specimens. [Station 2,095.]

The trawl was cast again at 2.44 P.M., in 1,451 fathoms, latitude 39° 22′ 20″ north, longitude 70° 52′ 20″ west. The bottom specimen brought up in the Sigsbee cup was the same as that of the former cast: but the trawl contained a granite stone weighing a hundred and seventy pounds, several small stones, small pieces of cinder, and lumps of hard clay; there were also several small specimens of what appeared to be oxidized iron. The haul was very successful, being particularly rich in foraminifera. [Station 2,096.]

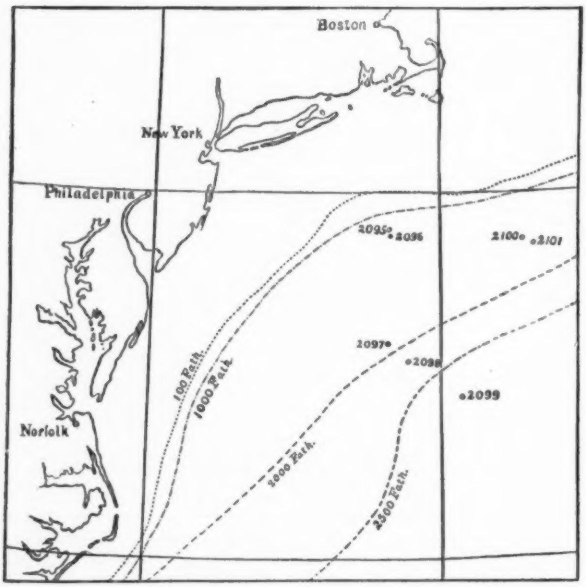
As soon as the trawl was up, a set of serial temperatures and specific gravities was taken to 1,000 fathoms. A temperature of 66° was found at 25 fathoms, 65½° at 60 fathoms, and 57½° at 40 fathoms. These strata of cold and warm water are the rule rather than the exception, in this locality; but, thinking that possibly the observation at 40 fathoms had been read incorrectly, it was verified, using another instrument, which registered 55½°.

At 8.22 P.M. we started ahead south ⅞ west

[1] Report to Prof. S. F. BAIRD, U. S. commissioner of fish and fisheries, by Lieut.-Commander Z. L. TANNER, U. S. N., commanding U. S. fish-commission steamer, Albatross, kindly placed at our service by Professor Baird. Some of the appendices are abbreviated to save repetition.

(magnetic), running on that course till 5.30 A.M., Oct. 1, when we sounded in 1,917 fathoms, — latitude 37° 56′ 20″ north, longitude 70° 57′ 30″ west; bottom, globigerina ooze, — and at 6.18 put the beam-trawl over, veering to 2,600 fathoms. It was on the bottom at 8.04; and at 9.04 we began heaving in, landing it on the deck at 10.42 A.M., having made a successful haul. [Station 2,097.]

At 2.08 P.M. the beam-trawl was lowered again in 2,221 fathoms, latitude 37° 40′ 30″ north, longitude 70° 37′ 30″ west. It was down, with 3,000 fathoms of rope out, at 4.03



P.M., dragged till 5.14 P.M., and was landed, after a successful haul, at 7.24 P.M. [Station 2,098.]

At 7.34 P.M. started ahead south-south-east (magnetic), ran till 3.26 A.M., and lay to until daylight (about 5.30 A.M.), when we sounded in 2,949 fathoms, — bottom, globigerina ooze; latitude 37° 12′ 20″ north, longitude 69° 39′ west, — near the centre of the Gulf Stream. The sinker, sixty-four pounds weight, was thirty-four minutes in reaching the bottom; and the specimen-cup came up in thirty-six minutes. The thermometer registered at some intermediate depth not far from the surface, having capsized in some way in its descent. [Station 2,099.] The net of the beam-trawl was examined with great care, and every foreign substance removed, so that there should be no doubt as to whether specimens found were taken during the haul, or were in the net when it went down.

At 7.14 A.M. the trawl was put over, reaching the bottom at 10.13½, having veered 4,100 fathoms of rope. At 0.54 P.M. began heaving up, and at 3.18 P.M. it was landed on deck. It was a successful haul in every respect.

The moderate breeze of the morning increased to a strong wind with heavy swell before the trawl was up, making it doubtful whether we should succeed in landing it. A set of serial temperatures and specific gravities was attempted after finishing the haul; but the strong current, high wind, rugged sea, and threatening weather forced us to give it up after having veered 300 fathoms of rope. The method adopted to regulate the drift was at least original. The current of the stream was so strong that the trawl would not take the bottom; and, to effect this object, an officer was stationed on the forecastle with a dredging quadrant, constantly observing the angle of the dredge-rope, the engines being moved with sufficient speed to maintain it within certain prescribed limits.

At 4.30 P.M., moderate gale from south-west; hove to under fore storm-staysail, head to the southward, drifting rapidly with the stream about north-east by east. At midnight it was blowing a moderate gale with heavy sea, barometer 29.76, the air exceedingly sultry, and incessant flashes of lightning in every direction. At 1.40 A.M., 3d inst., started ahead, course north, and ran under moderate speed till 11.05 A.M., when, wind and sea having moderated, we sounded in 1,628 fathoms, globigerina ooze, — latitude 39° 22′ north, longitude 68° 34′ 30″ west, — and at 12.13 P.M. put the beam-trawl over, veering to 2,300 fathoms. There was still a fresh breeze from north-west, with heavy swell and very strong stream. The trawl was down at 1.59, dragged till 3.08, and was landed at 4.25 P.M. There were some interesting specimens, but most of the things were washed out of the net on the way up. [Station 2,100.]

At 4.31 P.M. we sounded in 1,686 fathoms, globigerina ooze, — latitude 39° 18′ 30″ north, longitude 68° 24′ west, — and at 5.15 P.M. put the trawl over, veering to 2,650 fathoms. It was on the bottom at 7.10, began heaving up at 8.15, and landed it on deck at 9.39 P.M. The heavy swell and strong stream combined washed a large proportion of the specimens from the net, but several new or rare species were secured. [Station 2,101.]

A course was laid to the northward as soon as the haul was finished, and the speed registered so as to strike the 100-fathom line in longitude 67° 50′ west, at daylight, when we proposed setting a trawl-line for tile-fish. We were on the ground at the proper time; but the weather was so boisterous that it was not considered prudent to lower a boat. It was too rough even for dredging; and, as our coal-supply was nearly exhausted, we started for port.

We encountered strong head-winds during the day, finally anchoring in Tarpaulin Cove at 10.40 P.M., where we remained till 6 A.M. on the 5th, when we got underway, and arrived at Wood's Holl at 6.40, making fast to our moorings.

List of fishes obtained.

BY ENSIGN R. H. MINER, U.S.N.

Station 2,095. — Bathysaurus Agassizii, Stomias ferox, Macrurus asper, Coryphaenoides carapinus, Halosaurus macrochir, Haloporphyrus viola, Cyclothone lusca, and one new species.

Station 2,096. — Eurypharynx, Haloporphyrus viola, Macrurus asper, Synaphobranchus pinnatus, Halosaurus macrochir, Coryphaenoides carapinus.

Station 2,097. — Berycid (new species), Macrurus asper, Cyclothone lusca, Scopelus.

Station 2,098. — Macrurus asper.

Station 2,099. — Cyclothone lusca, Scopelus, Berycid (new species), two new species.

Station 2,100. — Cyclothone lusca, Scopelus, Forcipichthys.

Station 2,101. — Berycid (new species), Eurypharynx, Cyclothone lusca, Argyropelecus Olfersii, Sternoptyx diaphana, Scopelus, two new species.

Register of invertebrates captured.

BY J. E. BENEDICT.

The results obtained were good, notwithstanding the sea was quite rough much of the time. The surface-nets were in use when practicable, and a number of fine specimens were taken in them. As heretofore, schools of squid were seen in the water, illuminated by the arc-light. One of the crew captured

Dredging and trawling record.

Date.	Station.	Locality. Latitude, north.	Locality. Longitude, west.	Hour.	Temperature. Air.	Temperature. Surface.	Temperature. Bottom.	Depth in fathoms.	Kind of bottom.	Wind. Direction.	Wind. Force.	Drift. Direction.	Drift. Distance.	Trawl used.
1883.														
Sept. 30. .	2,095	39° 29′ 00″	70° 58′ 40″	9.02 A.M.	71½	69½	..	1,342	Glob. oz.	S.S.W. .	3	S. . .	2′.0	Beam.
" 30. .	2,096	39 22 20	70 52 20	2.07 P.M.	70	69	37½	1,451	" "	" .	2	S.W. .	1 .5	"
Oct. 1. .	2,097	37 56 20	70 57 30	5.30 A.M.	73	72½	..	1,917	" "	S.W. . .	3	S ½W. .	1 .5	"
" 1. .	2,098	37 40 30	70 37 30	1.08 P.M.	73	72½	..	2,221	" "	N.W. . .	4	W.×S.,	2 .0	"
" 2. .	2,099	37 12 20	69 39 00	5.30 A.M.	71	82	..	2,949	" "	S.E. . .	6	S.S.W.	2 .0	"
" 3. .	2,100	39 22 00	68 34 30	11.05 A.M.	63	69	37½	1,628	" "	W.N.W.,	3	E. . .	2 .0	"
" 3. .	2,101	39 18 30	68 24 00	4.31 P.M.	61	67	37	1,686	" "	W.S.W. .	3	S. . .	2 .0	"

Meteorological record.

Date.	Barometer. Maximum.	Barometer. Minimum.	Air. Maximum.	Air. Minimum.	Wet bulb. Maximum.	Wet bulb. Minimum.	Surf'ce water. Maximum.	Surf'ce water. Minimum.	State of weather.	Wind. Direction.	Wind. Force.	State of sea.
1883.												
Sept. 29. .	30.32	30.18	71	56	69	56	64	57	Passing clouds	E., N.W., S.	1–3	Smooth.
" 30. .	30.18	29.92	72	64	72	64	70	60	" "	S., S.S.W.	2–4	"
Oct. 1. .	30.06	29.86	80	66	78	65	75	71	" "	S.S.W., N.W., N.E. .	2–4	Moderate.
" 2. .	30.10	29.76	82	67	81	65	83	76	" " squally . . .	N.E., S.E., S.W. . .	2–8	Rough.
" 3. .	30.12	29.76	78	61	77	57	82	67	" " " . . .	N.N.W., W.N.W. .	3–7	"
" 4. .	30.36	30.12	64	45	62	43	66	55	Clear and pleasant	N.N.W., W.N.W. .	4–7	Rough, then moderate.

three of them with the squid-jig. Several land-birds were seen far out at sea. A pair of kingfishers (Ceryle alcyon) flew about near station 2,096. A pair of fish-hawks (Pandion haliaetus) acted as if they were at home near station 2,099, 250 miles from land. A golden-winged woodpecker (Colaptes auratus) and a song-sparrow (Melospiza melodia) came on board to rest, at station 2,100.

The principal invertebrates taken were as follows:—

Station 2,095. — The sounding-cup brought up ooze containing foraminifera from a depth of 1,342 fathoms. The beam-trawl was put over with wings attached. Among its invertebrates were twenty-five holothurians (Benthodites), many large Zoroasters, several cup-corals (Flabellum), a shrimp nine inches long with very large eggs, three specimens of a crab (? Galacantha). Some of the holothurians were placed in picric acid before putting them into weak alcohol. A portion of the eggs were taken from the large shrimp, and preserved in Müller's fluid for the study of the embryos, which were plainly visible within.

Station 2,096.— Again the sounding-cup brought up ooze with foraminifera, this time from a depth of 1,451 fathoms. Strange to say, a large stone, weighing upward of a hundred and seventy pounds, was brought up with sponges and worm-tubes attached. This would, I think, preclude the possibility of its being below the surface of the foraminiferous ooze, which came up in quantity sufficient to yield two quarts of clean foraminifera. The principal ingredients found in the stone were quartz, hornblende, and iron. Eighteen holothurians (Benthodites), many specimens of a small ophiuran, a few large shrimp, and some small shells, made up the bulk of the material.

Station 2,097. — Bottom, ooze, with foraminifera from a depth of 1,917 fathoms. One amphipod three inches and a half long, shrimp, Epizoanthus on hermit-crabs (species unknown), Urticina concors Verr. on Sympagurus pictus Smith, Ophioglypha convexa Lym. and Ophiomusium armigerum Lym. in small numbers, a starfish remarkable for its large madreporic plate and ambulacral feet, small ascidians coated with foraminifera.

Station 2,098.— Depth, 2,221 fathoms. Epizoanthus, Urticina concors Verr on Sympagurus pictus Smith, Ophioglypha convexa Lym. and Ophiomusium armigerum Lym., also a few shells.

Station 2,099. — This haul was remarkable from the fact that the sounding was in a depth of 2,949 fathoms. This is perhaps the deepest water ever successfully invaded by a large trawl: certainly it is the deepest we have record of with any trawl. The trawl went down more than three miles at the end of upwards of four miles and a half of wire rope without capsizing, and that in the middle of the Gulf Stream, while the water was quite rough. That there might be no question as to the specimens brought up, the captain had the net thoroughly cleaned before it was put over the side. The amount of material brought up was not large. The only specimens from the bottom were a species of Boltenia, and many fragments of a bryozoan we had not seen before. A fine large schizopod, with several species of shrimp and small crustacea, were taken in good condition. These, with a cephalopod and the fish, made it one of the best hauls.

Station 2,100, with a depth of 1,628 fathoms, and station 2,101 with a depth of 1,686 fathoms, brought us only shrimp and fish.

Specific gravities of sea-water.

BY P. A. SURGEON, C. G. HERNDON, U.S.N.

Date.	Station.	Depth.	Temperature air.	Temperature by attached thermometer.	Temperature of specimen at time specific gravity was taken.	Specific gravity.	Reduced to 60°.
12 M. Sept. 30 .	2,095	Surface.	71°	69°	71°	1.0251	1.026706
" 30 .	2,095	5	71	67	71	1.0251	1.026706
6 P. M. Sept. 30 .	2,096	Surface.	70	70	72	1.0251	1.026864
" .	2,096	5	70	67 .5	72	1.0251	1.026864
" .	2,096	10	70	68	72	1.0251	1.026864
" .	2,096	15	70	68	72	1.0252	1.026864
" .	2,096	20	70	67	71	1.0253	1.026906
" .	2,096	25	70	66	67	1.0257	1.026687
" .	2,096	40	70	57 .5	67	1.0264	1.027387
" .	2,096	60	70	55 .5	67	1.0263	1.027587
" .	2,096	100	70	55 .5	84	1.0236	1.027512
" .	2,096	200	70	47	85	1.0235	1.027600
7 P.M. Sept. 30 .	2,096	300	70	40 .5	85	1.0235	1.027600
" .	2,096	400	70	40	85	1.0235	1.027600
" .	2,096	500	70	40	85	1.0235	1.027600
" .	2,096	600	70	39 .5	86	1.0233	1.027616
" .	2,096	700	70	39 .5	85	1.0235	1.027600
" .	2,096	800	70	38 .5	85	1.0236	1.027700
" .	2,096	900	70	39	86	1.0235	1.027816
8 P.M. Sept. 30 .	2,096	1,000	70	38 .5	86	1.0235	1.027816
6 P.M. Oct. 1 .	2,097	Surface.	66	69	75	1.0253	1.027565
" .	2,097	5	66	68	75	1.0253	1.027565
2 P.M. Oct. 2 .	2,098	Surface.	79	74	76	1.0248	1.027232
" .	2,098	5	79	72	76	1.0248	1.027232
7 P.M. Oct. 3 .	2,101	Surface.	63	68	75	1.0246	1.026865
" .	2,101	5	63	69	73	1.0248	1.026724

THE ZOÖLOGICAL STATION OF HOLLAND.[1]

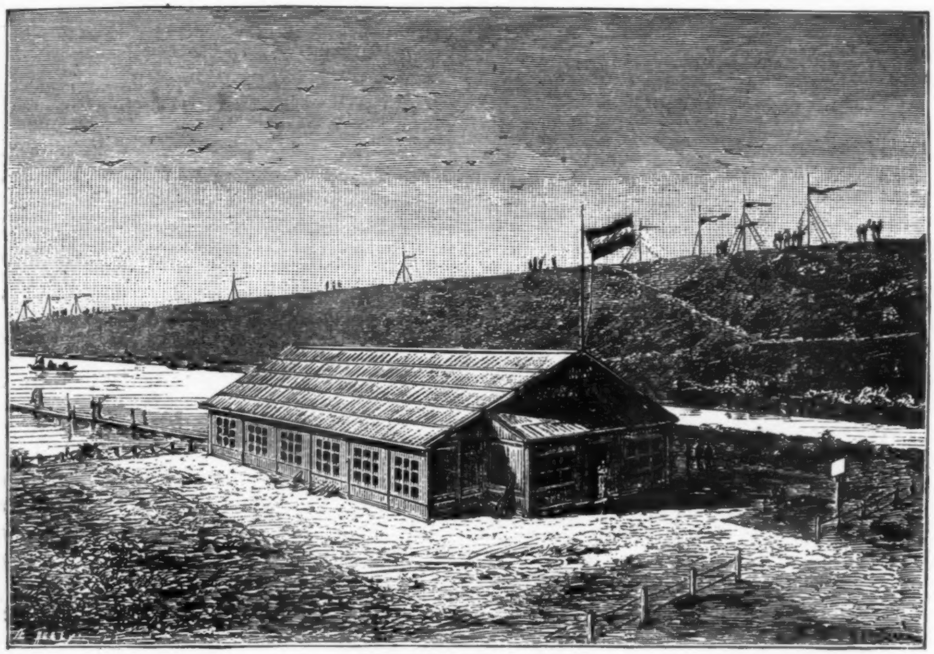
FOR some years past, zoölogical science has been pursuing a course abounding in brilliant discoveries. The examination, however minute, of animals preserved in collections, no longer satisfies the naturalist: he must study the living animal. Zoölogy has become experimental. On all sides, maritime stations are being established. Numerous works on anatomy and embryology have cleared up the philosophical theory of the transformation of animals by showing that the metamorphoses, which, less than half a century ago, were almost unknown, are very common among marine animals.

Holland, which has produced so many great anatomists and such patient naturalists, seemed to be tardy in following the example of neighboring nations, when, on the 4th of December, 1875, at the instiga-

[1] Translated from *La Nature* of Sept. 8.

tion of Professor Hoffman, its president, the Zoölogical society of the Netherlands voted to erect a zoölogical station on the shore of the North Sea. A committee, composed of Messrs. Hoffman, Hubrecht, and Hoek, decided on the erection of a station which could be easily transferred from one point to another on the Netherland coast. With its sandy shores and gradual slope, Holland has, it is true, a comparatively poor zoölogical fauna. The committee thought, therefore, and rightly, that a movable station would be more serviceable, as it would permit successive exploration of various parts of the shore.

The appeal made by the Netherland society to the forms which constitute the wealth of rocky bottoms. Few species can resist the sand which covers and smothers them. But while the downs extend west of the city of Helder, at the north there rises a spur of granite and basalt, in the irregularities of which numerous animals find shelter: it is the only point on the coasts of Holland where seaweeds are found. The minister of the marine having consented to place twice a week a steam-launch at the disposal of the commission, the little dredges invented by Wyville Thompson and the apparatus of Lacaze-Duthiers were employed, and a hundred and thirty species obtained.



THE DUTCH ZOÖLOGICAL STATION.

generosity of the state, to scientific societies and private individuals, met with a response; and the sum of ten thousand francs was soon obtained. Work was immediately begun. The choice for the first season fell upon the city of Helder, situated at the northern extremity of the province of North Holland, at a point where an arm of the sea, called Helsdeur, separates the mainland and the island of Texel. The material, loaded in a wagon drawn by cattle, reached its destination, July 8, 1876. Three days after, the station was in readiness, and studies were begun.

As throughout the coasts of the Netherlands, the bottom of the sea is, at Helder, chiefly composed of shifting sand; and one can scarcely, under such circumstances, expect to meet with those fixed animal

The second year the station was established at Flessingue; and the coast of Zealand proved not less rich in animal forms than the slope of Nieuvediep and the bank of Helder. In the years following, the station was at Bergen-op-Zoom.

During these latter seasons, the commission has not wholly devoted itself to the examination of animals which live on the coasts of Holland. Researches at the station have since aimed to furnish oyster-cultivators with information as complete as possible, on the anatomy, the embryology, the enemies, and diseases, in a word, on the biology, of the oyster. The eastern Scheldt has to-day become an important centre for oyster-culture; so much so, that the two stations, Kruiningen in Zealand, and Bergen-op-

Zoom in North Brabant, exported in 1881 about two million oysters, valued at some three million francs.

In order that the building may be easily taken to pieces and put in position, it is made entirely of wood; and the parts are arranged with such care that its removal from one place to another requires only three days besides the transit.

The station was at Bergen-op-Zoom when we visited it, and we were received by Professor Hubrecht with the cordiality and kindness characteristic of the *savants* of Holland. It is composed of a principal building about eight metres long and five broad. One façade has four windows; the other, three. The walls are three metres high; the ridge of the roof, four and a half. The framing of the roof is of wood, covered with a double layer of rush-matting. Opposite each window there is a stationary table: tables are also arranged in the centre of the room. In the laboratory are a closet for the instruments, another for the reagents and bottles, and also a small library, containing periodicals and the principal works on marine faunas. Each investigator can, in addition, send for books which he needs, either from the library of the zoölogical society, or from one of the universities of Holland. A desk, foot-rests, and some folding iron chairs complete the furnishings. The work-room, properly so called, is entered through a room in which are the aquaria, the collecting-apparatus, and the smaller dredges. The cumbersome instruments are placed in a room connected with one of the side-façades. Another room, opposite the entrance, leads into the private office of the director of the station. A fence of galvanized zinc wire runs around the building, and, while it wards off the thoughtless, encloses a space which may be used either for experiments in the open air, or for the dissection of animals of large size.

The construction of the house, as it stands to-day, has cost fifty-five hundred francs. An additional sum of six thousand francs was expended in the purchase of furnishings, aquaria, collecting-apparatus, reagents, thermometers, lenses, etc.

The management of the station is regulated in a very simple manner. The members of the zoölogical society nominate each year a committee, which publishes at the end of the year a report of the work, and gives an account of the funds expended.

Although the resources of the zoölogical commission are very limited, nevertheless the members have undertaken important work. During the season at Helder, Mr. Hubrecht was engaged upon fishes; Mr. Hoek studied the crustaceans; Mr. Horst, annelids; while Messrs. Van Harem, Noman, and Sluiter studied the other invertebrates. Mr. Hoek undertook, at Bergen-op-Zoom, his interesting researches on the embryology of the edible oyster. H. E. SAUVAGE.

LETTERS TO THE EDITOR.

The formation of tornadoes.

IN the discussion of Mr. Hoy's paper before the American association for the advancement of science, at the recent meeting at Minneapolis, I notice a number of statements which seem to me erroneous. Professor Rowland, for instance, asserts that "the rotation of the tornado is a necessary consequence of the earth's rotation." Now, if this be true, why are not tornadoes more frequent? Why is it necessary to have brisk, southerly winds, with high temperature and low barometric pressure? Why do they not happen on clear days as well as on cloudy ones? Again: if the earth's rotation determines the direction of the gyratory motion of tornadoes, why does it not govern the motion of the little whirlwinds occurring in dry weather? Every observer knows that these revolve, sometimes in one direction, and sometimes in the other, but perhaps, in a majority of cases, in the same direction as tornadoes.

It is well known that tornadoes in our latitude occur on days when there is a strong breeze from a southerly direction. Now, the air on such days, in spring and early summer, is heavily charged with moisture; to which fact is due the oppressiveness of the heat. As the heat of the day increases, local showers are formed, which move, not with the surface-wind, but in a higher current from a westerly direction. There is usually a divergence of about ninety degrees in the angle formed by a line indicating the direction of the track of the tornado, and another marking the direction of the preceding surface-wind.

Now, the mingling of these currents, or even the passage of one beneath the other, must, on account of their unequal temperatures, condense more or less of the moisture of the warmer current. This condensation is nearly always noticed. A cloud, often of intense blackness, accumulates just under the southern edge of the storm-cloud, and is usually prolonged horizontally to the northward along its base. If the cloud is near enough, so you can see beneath it, the parts farther in the rear will be seen to move rapidly in an easterly direction, just as the air-current moves which bears them. How can it be otherwise than that a gyratory motion shall result from such conditions? People frequently say, in describing a tornado, that "two dark clouds rushed together from opposite directions, and produced the tornado." This statement, if we are expected to construe it literally, seems somewhat absurd, since a cloud is always a passive element, moving only as the air moves in which it floats. That fragments of clouds and often quite large masses move toward each other is true; but tornadoes are not produced because of this, but on account of the *mutual resistance of two currents of air.* If two liquids or gases are brought together from different directions, a whirling motion is produced, as may be seen where two small streams of water flow together, or where a rock or fallen tree interrupts the direct movement of the water. This is but a necessary result of the combination of properties inherent in such a medium.

A volume of air, under pressure, escapes in the direction of least resistance: and, as there is a considerable pressure of the air where the two currents meet, an escape-current must form somewhere; and it forms, in accordance with the above law, in the direction of minimum resistance, obliquely upward to the east or north-east. As soon as this escape-current is developed, its position is at once located by a slender stem of vapor rapidly ascending obliquely; though, if the observer is at some distance, it seems to be suspended from the cloud above it, and even at times to descend toward the earth. Some of the downward movements of this 'funnel' are apparent only, the constantly ascending vapors sometimes condensing near to the ground, and at other times high in air. The funnel-cloud is often absorbed into the

cloud above, almost as soon as formed, the conditions necessary to its full development not existing.

In his excellent article on tornadoes, in the current number of the *Kansas City review of science*, Mr. John D. Parker speaks of the four characteristic motions of these meteors. These motions might be classified as horizontal and vertical. The horizontal motions are the linear, caused by the forward motion of the air-current governing the direction of the storm-cloud; second, the gyratory motion, caused, as above stated, by the mutual resistance of air-currents moving in different directions; third, the swaying motion, due partly to the varying pressure on different sides of the tunnel, and partly to the vertical or bounding motion of the tunnel. This latter motion would not have a very marked effect in producing the 'dentated edges' of the storm's path, if the tunnel-cloud were vertical instead of slanting. What causes the bounding motion it is difficult to say, but it certainly resembles electrical attraction and repulsion. This bounding movement was very marked in the tornado of April 18, 1869, which passed near this locality; but occurring, as it did, in the daytime, I could not distinguish the illumination of the lower part of the tunnel, which may sometimes be seen when these storms occur after dark, and which some think is due to electricity.

It is interesting to produce in miniature the horizontal motions of the tornado by the following simple experiment. When there is a good fire, let a small quantity of light, flaky ashes, or other light material, be sprinkled over the whole top of the cooking-stove. The heat forms quite a strong current, ascending mainly from the central parts toward the pipe. Cool currents flow in from all sides. Now, with the hand or a fan, produce local or opposing currents over the heated surface, and at once little tornadoes are developed, whirling the ashes several inches in the air. I have often produced them on both sides of the stove at the same time; those on the left moving as tornadoes in our latitude, and those on the right in the opposite direction. Now, are not the causes of the gyratory motion of the little whirlwinds on the stove, tiny as they are, the same in kind as those which produced the storms which devastated Marshfield, Grinnell, or Camanche? If this be answered in the affirmative, the rotation of the earth plays no direct part in causing the gyratory movement of this class of storms. Of course, the rotation of the earth causes the higher currents of air to move toward the north-east, instead of due north, as they pass from the equatorial to the arctic zone, and these currents determine the general linear movement of storms in our latitude; but this makes it proper to consider the gyratory motion an indirect result rather than a direct consequence.

S. A. MAXWELL.

Morrison, Ill., Oct. 9, 1883.

The chinch-bug in New York.

Why should Mr. Lintner conclude that the chinch-bug was brought to St. Lawrence county, N.Y., in a freight-car from the west? Harris corrects the erroneous idea that it is confined to the states south of 40° of latitude by demonstrating its occurrence in Illinois and Wisconsin, while Fitch's record of finding it in northern New York would justify us in assuming that it has always existed there, especially when we know that its range is much farther north. Packard found it on the top of the White Mountains; and it is to-day the most serious enemy that threatens the vast wheat-fields of Dakota. It seems to me more rational to consider this injurious manifestation in New York a result of undue increase of a species always there than to call it an invasion. Though we rarely hear of its injury in the Atlantic states, yet it is commonly met with where collecting is done near or in the ground, and in dry years is by far the most common Heteropter in grain and grass fields and dunes. This I know from personal experience, and have found it as far north as Boscawen, N.H.

Should it prove less susceptible to heavy and continued rains in New York than elsewhere, the fact will be remarkable. Such rains affect it most, however, in spring and early summer. My own interpretation of the interesting facts recorded by Mr. Lintner would be, that the species multiplied exceedingly during the very dry seasons of 1880 and 1881, and that the wet season, which it has so far braved (as it often does for a while in the west), will nevertheless tell on the hibernating bugs. In this view there is cause for encouragement rather than alarm. A careful survey would undoubtedly show, as Mr. Lintner suggests, that it exists in many places in the state where it has not yet been detected.

C. V. RILEY.

Washington, D.C., Oct. 24, 1883.

Unusual reversal of lines in the summit of a solar prominence.

On Oct. 17, between 3.45 and 4.30, local time (about 8.45 and 9.30 Greenwich time), a rather unusual phenomenon was observed at Princeton, in a prominence connected with the large and active group of spots which at that time was just passing off from the sun's disk.

The prominence had the very common form of a number of overlapping arches, with a sort of cap above them, or of a cloud connected by several curved stems to the chromosphere below. Its elevation was about 2′, and its extent along the sun's circumference a little less.

The peculiar features were the extreme brilliance of the cloud-cap at the summit of the prominence, and the perfect delineation of the form of this cloud in certain spectrum-lines, which ordinarily are reversed only at the base of the chromosphere; while, at the same time, certain other lines, which not unfrequently are reversed at considerable elevations, showed its form only very faintly, or not at all.

When I first came upon the prominence, in running around the sun's limb with the spectroscope, the brightness of the cloud-cap, as seen through the *C* line, was simply dazzling. I do not remember ever to have seen a prominence, or any part of one, quite so brilliant. At the same time, the line λ 6676.9 (which is in the same field of view with *C*, and is No. 2 of my catalogue of chromosphere-lines, — a line attributed to iron) also showed the top of the cloud quite as well and as brightly as is usual in *C* under ordinary circumstances. The chromosphere, also, was faintly visible in the same line; but the stems and lower portion of the cloud could not be seen at all in it. On turning to line λ 7055 (No. 1 of the catalogue), I was surprised and gratified to find the same appearances conspicuous in this line also. A careful search failed to show any other lines reversed below *C*.

Running up the spectrum from *C* to *D*, I could not find any lines showing the *top* of the prominence, though a considerable number were reversed in the chromosphere at its base. D_3, of course, showed the cloud-cap magnificently, but D_1 and D_2 only very faintly, though *distinctly* enough.

Between *D* and *b* the same remarks apply as between *C* and *D*. The corona-line, λ5315.9, was reversed at the base of the prominence a little more brightly

than in adjacent parts of the chromosphere, but not at all in the cloud-cap. The magnesium members of the *b* group showed the cloud faintly in the same way as the sodium-lines; but in b_3 the form was a little more conspicuous.

Between *b* and *F*, *two* lines (λ 5017.6 and 4923.1, both attributed to iron) showed the cloud-cap as beautifully as either of the two below *C*. Numerous other lines were reversed in the chromosphere, but none of them showed the upper parts of the prominence. *F* appeared much the same as D_3.

Between *F* and *G*, *five* lines were noted as showing the cap. The most refrangible of them was Lorenzoni's *f* (λ 4471.2): the other four I did not identify at the moment, being in haste to reach the violet portion of the spectrum, and intending to examine them later, — an intention I was not able to carry out, on account of the intervention of clouds.

The lines $H\gamma$ (λ 4340) and *h* were, of course, conspicuous, each showing the whole of the prominence. I expected that *H* and *K* would do the same, but was disappointed. They both exhibited the cloud-cap finely, but I could not make out in them either the stems of the prominence, or the spikes and knots of the chromosphere; and yet both the lines were well reversed, not only in the chromosphere, but also on the face of the sun itself, over all the faculous region surrounding the spots. The ultra-violet line above *K*, first observed here a few weeks ago, was not visible.

There was no considerable motion-displacement exhibited by any of the lines, — something rather singular in so brilliant a prominence, — nor did its shape change much during the forty-five minutes of observation.

It is perhaps possible that this cloud was indentical with a remarkably brilliant facular *bridge*, which was observed two days before, spanning the largest of the spots which composed the group: still this is by no means certain. The instrument employed was the nine and one-half inch equatorial, with the Clark spectroscope carrying a Rutherfurd grating, of about 17,000 lines to the inch; first-order spectrum.

C. A. Young.

Princeton, N.J., Oct. 22, 1883.

Sternal processes in Gallinae.

Having several times been asked the function of the long processes of the sternum as found in the Gallinae, I would make the following suggestions: —

If the sternum be examined *in situ*, the outer processes will be seen to extend far back, and well up the sides of the body, while the inner pair extend over the abdomen. The notches between the processes are closed by very tense, fibrous membranes. By this means a large area is afforded for the insertion of muscles with a minimum of bone. This must contribute slightly to diminish the weight of the posterior end of the body. Passing now to the muscles, we find that the great pectoral arises from the entire posterior border of the sternum, while the subclavius fills up the angle between the keel and body of the bone.

So much for the anatomy. What are the physiological results, and why could they not be attained in other ways? The results are an increased amount of pectoral muscle, and an increase in the length of the fibres, as compared with many other birds. Both of these are very desirable results for heavy birds of short, rapid flight, — the first, because with the increase in muscle comes a corresponding increase of force in the stroke of the wing; the second, because, by virtue of the long fibres, rapidity of contraction and a long stroke of the wing are secured. The rapidity is gained by all parts of the fibres contracting at once, whence the longer the fibre, the more quickly will a given amount of motion result. Both the first and the second are also aided by the fact that the first part of a muscular contraction is more powerful than the last part.

There is but one other way in which the same results, so far as the insertion of the muscles goes, could be attained; that is, by their origin from the ribs which lie under the sternum, as in the mammals, instead of from the overlapping sternum. To this, however, there is an all-powerful objection. If a man be watched while violently using his arms, it will be noticed that the upper part of the chest is held stationary. The pectoral muscles must have a firm point to pull from, in order to move the arms. As a result, respiration in the upper part of the chest is impeded, or, better, respiration is impeded by the diminished amount of tidal air. This principle is illustrated in the long, slow stroke, about twenty to the minute, of men trained to row great distances. The breathing is done, while the pectoral muscles are relaxed, at the normal rates. The same, only in a much greater degree, would hold good for birds. Were the muscles inserted into the ribs, respiration would be interrupted several times each second during flight: hence it is evident that the muscles could not be inserted into the ribs.

But again: why should the Gallinae require rapid powerful motions of the wings? Why should they not have long wings, and a comparatively slow stroke? This is forbidden by their habits. Long wings would be very cumbersome when the bird was on the ground, and absolutely worthless in much of the brush through which a grouse will fly with wonderful rapidity.

Therefore we may say that the processes are developed to give, with the greatest economy of material, a large area for the insertion of the pectoral muscles in such way as not to interfere with respiration, and that such area is required for the flight of the bird.

J. Amory Jeffries.

A bifurcate tentacle in Ilyanassa obsoleta.

Some years ago, when collecting for my marine aquarium, in Raritan Bay, at Keyport, N.J., I obtained an Ilyanassa obsoleta of such a strange form, that I made a pencil-sketch and notes of it at the time. The left tentacle was bifurcated at the shoulder, or place where the normal tentacle abruptly narrows. The two sub-tentacles thus caused, seemed to be equally sensitive, as each was capable of separate and independent movement. Several instances have been long known to me of bifurcation of the caudal spine of Limulus; but the additional prong in every instance was functionless, and, in fact, an inconvenience. I have also seen malformed antennae in microscopic insects. As I have not heard of a similar instance in the mollusca, it seemed to me that the case should go on record.

Samuel Lockwood.

Freehold, N.J.

The mechanism of direction.

Shortly after reading Professor Newcomb's paper in Science for Oct. 26, 1883, I had the pleasure of meeting him, and of discussing some matters of mutual interest in regard to subjective states of consciousness. It seems to me that the professor does not give sufficient weight to habit, and to unconscious cerebral action. In the strict sense of the word, one is not always *conscious* of the way he is going; for although he may avoid obstacles of any kind, yet he may pass

some distance beyond his abiding-place by reason of mental pre-occupation. There are two lines of cerebral action going on at once, — one, the active mental study which engrosses him; the other, the unconscious action that keeps him out of danger from passing vehicles, or from other causes incident to city life. The limitation of direction which Professor Newcomb regards as exceptional, I consider as general: i.e., I believe that there are vastly more men who have no definite idea of lines as a standard of reference, than there are those who refer every thing in direction to such co-ordinates; just as there are many who never have any definite idea of the cardinal points of the compass, either as real or ideal points, and who never arrive at any clear conception of the bearings of familiar buildings, or the direction of streets, though they may live in the same city for years. The domination or tyranny of a fixed idea is explanatory of the difficulty which Professor Newcomb experiences. His ideal or subjective west was the domination of a fixed idea indelibly imprinted upon the super-sensitive cerebral cortex of youth, not necessarily associated with ideal or absolute direction, or with any system of horizontal lines, but an isolated conception, formed out of the perception of different positions, which in early youth could hardly be correlated with any abstruse reasoning. This idea of west, once ingrafted upon a developing brain, became a fixed factor, so dominant as to tyrannize over the understanding, and so persistent as to require some moments of study to dispel the illusion. This becomes evident from an analysis of his third division. The tyranny of the early idea has usurped control over the will, and, indeed, over the whole cerebral outcome. Even though the internal evidence corresponds with the external bearings to show that his preconceived west is really *not* west, but some other point, yet so strong is the power of this subjective idea, that by no process of argument can he rid himself of it. This is not uncommon, but by no means of frequent occurrence. But it is not a normal harmony of relation between the various reciprocal functions of the brain. It is likened to a habit formed in youth, so strong as to be ineradicable in manhood, and has been studied with much care by psychologists. Again: one may be mistaken as to direction, or become confused in tracing his route through the intricacies of his hotel, without associating such perversions with any states of subjective consciousness, so far as these states may involve the consideration or differentiation of the 'co-ordinates.' A man who is ignorant of the cardinal points of the compass, and who never can tell in which direction he is facing, loses his way because he has lost his bearings: the road was known by reason of the association of other facts, — a certain house just here, or a lamp just there, — and not because his horizontal lines have led him astray. In view of what we have learned of unconscious cerebral action, of habit, of the association of ideas, of the tyranny of a fixed idea, and of subjective states of consciousness leading on to abnormal objective conditions, it seems to me that Professor Newcomb's case is not an isolated one, and that what he has written of himself has already been written of and discussed.

HORATIO R. BIGELOW, M.D.

Washington, D.C.

Colorado climate.

For the benefit of other sufferers, please allow me to correct what is likely to lead to an erroneous impression, on reading Dr. Fisk's article on 'Climate in the cure of consumption,' as published in SCIENCE of Oct. 5. Dr. Fisk, in his very able article, like most of those who have written of the fitness of the climate of Colorado for consumptives, speaks as though Denver City were Colorado, and *vice versa*.

Now, this unintentionally misleading impression is calculated to do serious harm. During the late spring, and in summer and autumn, Denver and neighboring localities may be quite as pleasant and beneficial to the consumptive as localities south of the 'divide' that separates the waters of the Platte from those of the Arkansas.

But, during the cool and cold months, the Arkansas valley furnishes a very much better climate than can be found anywhere north of this divide in Colorado. It is scarcely necessary to state that the Arkansas valley furnishes all the necessary comforts of civilization, including convenient railroad transportation. As a rule, with rare exceptions, the consumptive should not sojourn in towns or cities, but rather in rural districts. But, should the consumptive prefer town or city life, Pueblo, Cañon City, and other places in the Arkansas valley, afford ample accommodation.

Having long been a sufferer myself, and having sought health in many portions of North America, I speak of the before referred to localities from observation and experience, and without prejudice or pecuniary interest.

Q. C. SMITH, M.D.

Austin, Tex., Oct. 18, 1883.

[Dr. Fisk's article was written with especial reference to Denver, as the necessary data exist for that place, furnished by the records of the signal-service station: these do not exist for localities in the Arkansas valley. — EDITOR.]

A BIOGRAPHICAL HISTORY OF ASTRONOMY.

Heroes of science — astronomers. By E. T. C. MORTON, B.A., scholar of St. John's college, Cambridge. London, *Society for promoting Christian knowledge*, [1882] 341 p. 16°.

FROM the title, 'Heroes of science — astronomers,' one might expect to find in this little book an account of the lives and a eulogium of the characters of the greatest astronomers, with some general indication of the nature of their discoveries. This expectation would be partially corrected by the opening paragraphs of the preface: —

"The primary object of this little book is, as its name implies, to give some account of the lives of the chief astronomers. But it is impossible to leave in the mind of the general reader any clear notion of their characters, without giving some account of their work. A good deal of space is therefore taken up with explanations of their discoveries; but, as this is only of secondary importance, the explanations are given in a popular manner, and no mathematics is introduced, except in ten pages (172–182), where a knowledge of the first book of Euclid and of the elements of algebra is assumed.

"The book may possibly be useful as an introduction to the study of astronomy, and, in this aspect of it, it is hoped that it may be helpful in two respects: First, by putting before the student the personal difficulties which the first investigators of the law

of the stars met with, and the struggles they passed through to overcome them, whereby a human interest is given to the study of their work; and secondly, by clearly indicating the nature of the problems to be solved by the science."

In point of fact, however, the book does much more than this: it presents a clear, connected, readable account of the chief steps in the progress of astronomy from the earliest times to the present day; and while the lives of the astronomers, judiciously inserted and as a rule well told, greatly heighten the interest of the story of the science, the reader always feels that they are only the accidents of the book, while the unfolding of the successive triumphs of astronomy, and the exposition of its laws, objects, and methods, is its constant purpose.

Interesting and readable as the book is almost throughout, we nevertheless think the author mistaken in regarding it as well adapted to serve as an *introduction* to astronomy for non-mathematical readers. It is true that only very elementary mathematics is explicitly introduced; but few readers who are not either equipped with the habits of thought bred by mathematical study, or possessed of some familiarity with the outlines of astronomy, can follow intelligently and with interest the discussion of complicated motions. To young people who have gone through an elementary course in astronomy, on the other hand, the book before us will be most instructive and stimulating. The subject is vivified, not only by the presentation of the lives, so full of inspiration, of the great founders of the science, but also by a far clearer view of its progressive development than an ordinary text-book can afford. And the impression is not weakened by the introduction of insignificant details, or of merely statistical information. Not that details are avoided when they are necessary to the exposition or illustration of a great law, or of an important phenomenon: on the contrary, one is surprised at the number and diversity of the points which are explained, and in general clearly and satisfactorily explained. The author has not refrained from giving simple expositions of mechanical and physical laws when they are essential to the clear understanding of astronomical doctrines. By explaining the laws of motion, for example, and insisting on their fundamental importance, he puts the reader in a position to understand the great problem of physical astronomy, and to appreciate its solution. In connection with spectrum analysis, a little space devoted to the analogy between sound and light makes the subject clear to the average reader. And many other instances might be mentioned.

As the character of the book does not make it incumbent upon the author to present any thing like a complete survey of even the most prominent astronomical facts, he is able to give a much fuller exposition of the central points in the theory of astronomy than one would expect to find in so limited a space, and to give intelligible accounts of many things having a direct connection with these central principles, which are usually passed over with a bare mention in small works on astronomy. Thus, more than eighty pages are devoted to Newton, only a small portion of which is biographical, a whole chapter of fifty pages being specifically devoted to the Principia. And pretty full accounts are given, for example, of Herschel's theory of stellar distribution, of the nebular hypothesis, of Laplace's proof of the stability of the solar system and Lagrange's previous attempts in that direction, and of the recent researches of Mr. G. H. Darwin.

It would be quite possible to point out minor defects in the book. There is occasionally (but very seldom) an attempt to explain what cannot be satisfactorily explained in a popular manner; once in a while the demonstrations, which are usually in excellent and attractive form, are made pedantically stiff; there are a few inaccuracies, chiefly of expression; and there are possibly a few cases of Sunday-school moralizing from insufficient premises. The only instance we have noticed of unfairness in the historical portion is in the passage relating to the Mohammedan astronomers. Scant justice is done them; and the author permits himself to combine silliness with injustice in saying that 'it illustrates the slavish stupidity of the race,' that a discovery made by an Arab astronomer in the tenth century was afterwards forgotten by them! A grave defect, but one which can easily be remedied in a new edition, lies in the lack of an index, — an omission which seriously impairs the value of this very interesting and useful work. In conclusion, lest we should leave the impression that the book can be read with advantage only by students, we would say that the chapters which combine in the highest degree biographical with scientific interest, — those on Copernicus, Tycho Brahe, Kepler, and Galileo, — and many other parts of the book, may be read with great pleasure and profit by a very wide circle of readers.

PROCTOR'S GREAT PYRAMID.

The Great Pyramid: observatory, tomb, and temple. By R. A. Proctor. London, *Chatto & Windus*, 1883. 323 p., illustr. 8°.

This last work of Mr. Proctor's fertile and ingenious mind is of uncommon and enduring interest. To begin with, it concerns the most uncommon and the most enduring work of man, — the Pyramid of Cheops, whose mighty form has for nigh five thousand years remained the least changed and the least comprehensible of all man's great deeds. Then it comes happily into a discussion which is by far the most curious that has recently vexed the minds of learned men. There are plenty of paradoxical folk on the lower confines of science, — circle-squarers, Symms'-hole hunters, and the like; but men of learning, especially astronomers and mathematicians, are a hard-headed lot. The crack-brained do not often find their way up to their upper heights, for evident reasons. But it is a set of these really learned people that has given us the sect of the pyramid worshippers, — the most extraordinary cult of a century, that, of all the Great Pyramid has ever seen, has been the most fertile in religious whims.

Active proselyting not yet having begun, perhaps for want of needed martyrs, the general public has as yet heard little of the pyramidalists or their faith. This is surprising; for their faith has more miracles 'to the acre' than Mormonism, and these miracles are as solid and ponderable as the pyramid itself. They are before our eyes: hundreds of pages of mathematics are needed to express them, and they have all the cheap look of certainty which the public associates with algebraic formulae. The following is in brief the history of pyramidalism, the only mathematical *ism* of the nineteenth century. Many years ago a Mr. John Taylor, pondering on the matter of the Great Pyramid, — which, by the way, he had not seen, and never saw, — came to the extraordinary conclusion that the architects of the structure recorded in its proportions, and in the arrangement of its chambers and passages, certain religious and astronomical truths, which they intended should, after thousands of years of secrecy, be divulged in our day. Mr. Taylor, being otherwise unknown to fame, though clearly entitled by this tour of imagination to rank high among speculators, found no able advocates of his notion, until his book came in the way of Professor Piazzi Smyth, astronomer royal of Scotland, one of the most distinguished astronomers of our time. Captivated with this daring hypothesis, Professor Smyth visited the Great Pyramid, spent many months in a careful and costly survey of the structure, and, in his successive writings on the subject, has not only re-affirmed the conclusions of Taylor, but immensely extended the range of his conclusions. Briefly stated, his position is this: some three thousand years or more before our era, a Semitic prince, probably Melchizedek, that vast shadow of the time, inspired by God, went to Egypt, gained an intellectual mastery over King Cheops, and forced him to build this pyramid, which was designed to "keep a certain message secret and inviolable for four thousand years, . . . and in the next thousand years it was to enunciate this message to all men; . . . and that part of the pyramid's usefulness is now beginning."

This 'message' is thus summed up by Mr. Proctor: —

"The Great Pyramid was erected, it would seem, under the instructions of a certain Semitic king, probably no other than Melchizedek. By supernatural means, the architects were instructed to place the pyramid in latitude 30° north; to select for its figure that of a square pyramid, carefully oriented; to employ for their unit of length the sacred cubit, corresponding to the twenty-millionth part of the earth's axis; and to make the side of the square base equal to just so many of these sacred cubits as there are days and parts of a day in a year. They were further, by supernatural help, enabled to square the circle, and symbolized their victory over this problem by making the pyramid's height bear to the perimeter of the base the ratio which the radius of a circle bears to the circumference. Moreover, the great processional period, in which the earth's axis gyrates like that of some mighty top around the perpendicular to the ecliptic, was communicated to the builders with a degree of accuracy far exceeding that of the best modern determinations; and they were instructed to symbolize that relation in the dimensions of the pyramid's base. A value of the sun's distance more accurate by far than modern astronomers have obtained (even since the last transit of Venus) was imparted to them, and they embodied that dimension in the height of the pyramid. Other results which modern science has achieved, but which by merely human means the architects of the pyramid could not have obtained, were also supernaturally communicated to them; so that the true mean density of the earth, her true shape, the configuration of land and water, the mean temperature of the earth's surface, and so forth, were either symbolized in the Great Pyramid's position, or in the shape and dimensions of its exterior and interior. In the pyramid, also, were preserved the true, because supernaturally communicated, standards of length, area, capacity, weight, density, heat, time, and money. The pyramid also indicated, by certain features of its interior structure, that when it was built the holy influences of the Pleiades were exerted from a most effective position, — the meridian through the points where the ecliptic and equator intersect. And as the pyramid thus significantly refers to the past, so also it indicates the future history of the earth, especially in showing when and where the millennium is to

begin. Lastly, the apex or crowning stone of the pyramid was no other than the antitype of that stone of stumbling and rock of offence, rejected by builders who knew not its true use, until it was finally placed as the chief stone of the corner. Whence, naturally, 'Whosoever shall fall upon it' — that is, upon the pyramid religion — 'shall be broken; but on whomsoever it shall fall, it will grind him to powder.'"

It would require all the space of this number of SCIENCE to print in full array the evidence on which these conclusions are rested. At every step the able astronomer royal of Scotland has fortified his conclusions by careful measurements of the Great Pyramid. His method of working is as follows: having found that the unit of measurement is a certain length, about an inch, which he terms the 'pyramid inch,' he seeks, in the various measurements of the structure, for correspondences in number of these units with natural and historic units, the distance of the sun, the radius of the earth, etc. Finding a correspondence, or *a close approximation to a correspondence*, he assumes that this ratio was intended by the builders to be a statement of this truth. At first sight, the number and accuracy of these correspondences is simply astounding: they look like insuperable facts. Moreover, the measurement of the sun's distance, and perhaps some other ratios from the Great Pyramid, may turn out in the end to be closer to the truth from the pyramid revelation than they are to our present measurements.

After a sagacious review of the principal coincidences, and an effort to show their generally unintended nature, Mr. Proctor proceeds to develop his own view, which is, in effect, that the pyramids were built for astrological observatories, designed for the casting of the horoscopes of the successive kings. He shows clearly, and we believe was the first to show, that early astronomy was astrological in its aims, and that the pyramid, when it had been carried up to half of its height, would afford the best possible structure for astronomical work of that time. His ingenious, and we must say convincing, argument requires us to assume a much more advanced state of astronomical and geodetic science in those days than many would be willing to admit. Still, the old Semitic civilization is a vast unexplored realm: it is a vain fancy that we yet know what it contained. It is easier to give to it any thing in the way of learning than to accept the monstrous scheme of bungling prophecy that the pyramidalists offer in its stead.

The student of science may have something beyond the entertainment that all readers will find in this book, and the literature of which it will form an important part. He may find in the controversy a suggestion of certain dangers that await all work of a theoretic kind. All the work of extending our conceptions of natural phenomena, all the work of true science, must be carried on by the method of coincidences. A fact, or series of facts, is compared with other facts or series, and, from their observed identities, relations are inferred. The use of this method, under rigorous scrutiny, has given us our modern science, and must give us all that is truly scientific in the time to come. The incident of the Great Pyramid inquiry may well lead us to notice certain dangers in this method. A large part of the facts with which the naturalist has to deal has for him the danger that the Pyramid of Cheops has for the mathematician. Between the thing in hand and other things, there is a practically infinite number of relations. If he sets out on his inquiry with a mind to find resemblances of a certain kind, this liberal nature is sure to gratify him. Nothing but the most rigorous correction of the reasons for an opinion by the reasons against it will keep him safely on his way.

The more fixed the opinion that guides the student in his work, the surer he is to find in the infinite that any object offers the facts to support his views. This is the great danger that lies in the way of many who are seeking to advance the development hypothesis in biology. Having become possessed with the conviction that certain things are to be found, they will see them as Smyth sees revelation in the stones at Ghizeh.

There are some faults to be found with the *making* of this book. More than one-third of it consists of separate essays on the origin of the week, — Saturn, and the sabbath of the Jews; astronomy and Jewish festivals; the history of Sunday; and astrology, — all very interesting in their way, but they are not represented in the title. There is no proper table of contents, and no index. The British seem determined to leave this work of opening their modern literature to students, altogether in the hands of the Index society.

The book is written in the admirable didactic English of which the author is a master.

MINOR BOOK NOTICES.

Man before metals. By N. JOLY. New York, 1883. (International science series, no. 45.) 8+365 p., illustr. 8°.

THE author of this attractive volume, unlike many European writers on archeology, gives but little space to the subject of North-American antiquities; and, of the one hundred and

forty-eight illustrations, not one represents a characteristic stone implement of this country. The little that our author finds to say under the comprehensive title of 'Prehistoric man in America' is included in twelve pages, constituting chapter vii., and is mainly a review of Squier and Davis's Ancient monuments of the Mississippi valley, with brief reference to certain discoveries recorded so long ago as the publication of Gliddon and Nott's Types of mankind. Mr. Joly might readily have done far better. No mention is made of the vast amount of material gathered within the last decade, that bears so strongly upon the vexed question of man's antiquity on this continent. The scores of publications of the Smithsonian institution, the invaluable reports of the Peabody museum, and the transactions of our learned societies generally, have been quite overlooked; and a vain attempt has been made, in lieu thereof, to bolster up the claim of antiquity of America's earliest people by reference to the mounds of the Ohio valley, many of which have recently lost their claim to a pre-Indian origin, and others, doubtless, will yet be shown to have been erected by the ancestors of our modern redskin. As a *résumé* of European archeology, it is valuable, but not otherwise. To the American students of the science it will prove disappointing.

Hydraulic tables for the calculation of the discharge through sewers, pipes, and conduits; based on Kutter's formula. By P. J. FLYNN. New York, *D. Van Nostrand*, 1883. (Van Nostrand's science series, no. 67.) 135 p. 24°.

KUTTER'S formula for determining the velocity of flow of water is one of the class which has the general form $v = c\sqrt{rs}$, where r is the ratio of the cross-section a to the wetted perimeter, and s is the sine of the slope; but the coefficient c is of such a complex form, that the application of the formula to definite problems in water-supply and sewerage is somewhat tedious. This collection of tables is designed to facilitate the work, and gives values of r, $c\sqrt{r}$, and $ac\sqrt{r}$, for circular and egg-shaped sections, and of s and $\sqrt{s}$ for different slopes. The coefficient of roughness or friction used is .015, and a number of examples make clear the use of the tables. Engineers who have such work in their practice will find these tables convenient.

Chemical problems, with brief statements of the principles involved. By JAMES C. FOYE. New York, *Van Nostrand*, 1883. (Van Nostrand science series, no. 69.) 6+141 p. 24°.

THE value of chemical problems as a practical illustration of the rules of stochiometry is recognized by every teacher of chemistry. A thorough knowledge of chemical arithmetic is constantly required in the laboratory, and it can only be gained by actual practice in the solution of problems. The convenience of having a collection of examples at hand will therefore be appreciated by teachers; and this book will doubtless supply a deficiency to those who prefer the problems arranged independently of the text-book. A great variety of examples are presented, with very full illustrations of the relations which exist between the factors and products of chemical reactions, beside calculations of atomic and molecular weights, specific and latent heat, specific gravity and vapor density. Examples are also introduced on the metric system of weights and measures, thermometric scales, and the laws of Mariotte and Charles.

WEEKLY SUMMARY OF THE PROGRESS OF SCIENCE.

ASTRONOMY.

Origin of the lines A and B in the spectrum. — M. Egoroff, by experiments at the physical laboratory of the University of St. Petersburg, has shown that the lines of the solar spectrum known as *A* and *B* are due to the oxygen of our atmosphere. He employed a tube twenty metres in length, closed with glass plates, in which tube the gas under investigation could be condensed under pressures of fifteen atmospheres or less, proper care being taken to dry it thoroughly. The telluric character of these lines has been generally admitted, but has of late been called in question by Mr. Abney, who suggested that they might be due to cosmical hydrocarbon gas of some kind, diffused through space in accordance with Siemens's theory. M. Egoroff sets this question at rest, having determined by direct experiment that none of several different hydrocarbons tried gives any such bands, while oxygen unmistakably does give them. — (*Comptes rendus*, Aug. 27.) C. A. Y. [327

On the assumption of a solar electric potential. — Werner Siemens discusses the hypothesis proposed by his brother (Sir W. Siemens), that the sun has a high electric potential, due to the friction of the dissociated matter which, according to his

theory, is continually flowing in at the sun's polar regions to replace that which, after combustion, is thrown off at the sun's equator. The paper is an important one, but too long to be fairly summarized within our limits. A considerable portion of it is devoted to an endeavor to obviate one of the most serious objections to Siemens's theory of the solar heat; namely, the objection based on the resistance to planetary motions which would result from a cosmical interstellar medium of the necessary density. Werner Siemens argues that the particles of matter passing off from the sun's equator would continue to revolve around the sun as they receded from it, and at any distance would have the same velocity as a planet at that distance, and so would offer no resistance. The paper is, however, mainly occupied with the planetary consequences of solar electrification. — (*Phil. mag.*, Sept.) C. A. Y. [328

MATHEMATICS.

Development of real functions. — The exact title of this paper, by M. J. P. Gram, is 'The development of real functions in series, by the method of least squares.' M. Gram's paper is an exceedingly interesting one, but unfortunately one which cannot be more than briefly referred to in this place, as a suitable notice of it would require the reproduction of a great deal of algebraical work. The principal problem which M. Gram proposes to solve is stated as follows: let there be given a series of arguments, x, and two corresponding series of quantities, o_x and v_x. These last quantities are all real, and, further, the v_x are all positive. Then in a series which contains known functions of x, — viz., $y_x = a_1 X_1 + a_2 X_2 + \ldots + a_n X_n$, — the coefficients are to be so determined that $\Sigma_x v_x (o_x - y_x)^2$ shall be a minimum. In the first part of the paper, the author gives applications of his process to Fourier's series, spherical harmonics, and cylindrical functions. The second part refers almost entirely to the convergence of certain series; but without quoting much that is obtained in the first section, and defining many symbols, it would be impossible to give here a suitable or intelligible notice of this second section. — (*Journ. reine ang. math.*, xciv. 94.) T. C. [329

ENGINEERING.

Economical pumping-engines. — Mr. C. T. Porter reports the duty of the Gaskill engines at Saratoga as 106,000,000 pounds, raised one foot high, per 100 pounds of hand-picked coal. The Corliss engines at Pettaconsett, Providence, R.I., gave a duty of 113,271,000; and the Pawtucket engines have an average, for the year 1882, of 113,500,000. The slip of valves is reduced to one-half of one per cent. — (*Mech.*, July 21.) R. H. T. [330

Consolidation of bulky materials. — A steam-hammer has recently been applied to the consolidation of bulky materials in steel moulds. The materials are usually organic, often fibrous, and one blow generally does the work. Four blocks per minute are made; 3,000 pounds of sawdust are compacted into blocks each hour. Bran is thus made denser than flour, and can be preserved indefinitely. Stone is made from earth or sand, and weighing 160 pounds per cubic foot. The following are results so obtained: —

	Cubic feet per ton.		Weight per cubic foot.	
	Unpressed.	Pressed.	Unpressed.	Pressed.
Bran	172	34	13	65
Meal	64	37	35	65
Sawdust . . .	448	34	5	65
Tanbark . . .	140	35	16	64
Cotton (baled) .	93	40	–	56
Hay " .	160	34	14	65
Bitum. coal-dust.	44	28	50	80

— (*Industr. world*, June.) R. H. T. [331

Economy of steam-boilers. — William Kent reports, to the American society of mechanical engineers, the results of a series of tests of fuels in various ways, and under various forms of boilers. He gives the following as relative values of fuels determined by burning under the Babcock & Wilcox boilers: —

Welsh bitum.	109.6.
Scotch bitum.	109.5.
Cambria, Penn., semi-bitum. . . .	91.2.
Pittsburgh, Penn., bitum.	99.5.
Ohio bitum.	84.9.
Vancouver's Island	85.7.

The paper is long and unusually complete. — (*Ibid.*) R. H. T. [332

METALLURGY.

Bessemerizing copper mattes. — Pierre Manhés claims to have overcome all the difficulties in Bessemerizing copper matte, and to have charge of an establishment which is, at the present time, successfully making copper on a commercial scale. He melts the ore in a suitable cupola furnace, casting the matte produced into a Manhés converter, when, under the action of a high-pressure blast, it is rapidly transformed into 98% to 99% black copper. The Manhés works consist of three cupolas of twenty-five to thirty tons' capacity per day; two small cupolas for remelting the matte in case of need; three Manhés converters, treating a ton and a half of matte at each operation, and each converter makes twenty-two to twenty-four operations per day; and the necessary blowing-engines. Manhés claims that cost of labor is reduced to a minimum, because operations last only a few minutes, and large quantities of metal are handled. The cost of fuel is low; because no fuel is needed to bring the matte forward to black copper, except that used for the blowing-engine. The saving in cost over the Welsh or Swansea process, according to local conditions, is from 50% to 75%. — (*Eng. min. journ.*, June 30.) R. H. R. [333

AGRICULTURE.

Seed-testing. — Comparisons between the germinating and vegetating powers of seeds, made at the New-York agricultural experiment-station, show that the two are by no means identical. Many seeds which were capable of putting forth a radicle failed

to vegetate sufficiently to form cotyledons, under the favorable conditions of a testing-apparatus. In eleven tests, with four species of seeds, from ten to forty-six per cent of the seeds germinated, but failed to vegetate. — (*N. Y. agric. exp. stat. bull.*, lxii.) H. P. A. [334

Sulphuric acid as a fertilizer. — The use of sulphuric acid has been proposed as a means of rendering the constituents of the soil soluble. Experiments by Farsky on summer rye, grown in boxes, showed no advantage from the use of sulphuric acid or of acid sodium sulphate. When the soil was kept dry, a slight decrease in the production of grain was noticed as the result of the manuring. The soil was a clay soil, and the sulphuric acid was sprinkled upon it in the concentrated form until it was distinctly moist. A hundred grams of acid were used to thirty-five hundred grams of soil. — (*Biedermann's centr.-blatt.*, xii. 447.) H. P. A. [335

GEOLOGY.

Lithology.

Determination of the felspars in rocks. — Professor J. Szabó's method of determining the felspars in rocks was published at Budapesth in 1876; but he has recently placed it before the English reading public in a paper read at Montreal last year. His method consists chiefly in determining the coloration of the flame by the felspars, and their fusibility. This method, with the addition of Boricky's micro-chemical process, is further used by Szabó for the determination of other silicates. For the details of the process, reference is to be had to the original papers. — (*Proc. Amer. assoc. adv. sc.*, 1882.) M. E. W. [336

Laterite from Huranbee, Pegu, India. — This is described by Dr. R. Romanis as an aqueous rock of a bright red color, friable, and full of cavities. It is stated to be composed of 31.44% of quartz sand, 13.27% of soluble silica, 36.28% of ferric oxide, 9.72% of alumina, and 8.83% of water. When the sand is examined under the microscope, it is seen to be water-worn. Laterite is much used in building and road-making on account of its hardening when exposed to the air. — (*Trans. Edinb. geol. soc.*, iv. 164.) M. E. W. [337

MINERALOGY.

Minerals from Amelia county, Va. — In a vein of granite which for the past few years has been worked for mica, a few rare and interesting minerals have been found, and are described by William F. Fontaine. Columbite occurs in crystals of large size, and rather rarely a manganese variety of a chestnut-brown color is found. This latter has a tendency to assume a fibrous structure. Orthite is found abundantly in long, bladed crystals. The most interesting mineral found at the locality is microlite, occurring both in crystalline masses of large size, and in distinct crystals: the latter are octahedrons, modified by small cubic, dodecahedron, and tetragonal-trisoctahedron faces. Analysis has shown that the mineral is essentially a calcium tantalate. Monazete, another rare and interesting mineral, is found abundantly at the locality, sometimes in masses weighing several pounds. Analyses have shown that this has the composition of a normal phosphate of the cerium metals, while the thorium, which is most always present, and abundantly in the monazete from Amelia, is due to an admixture of a silicate of thorium. Helvite, a rare silicate of manganese, beryllium, and iron, containing sulphur, is found sparingly associated with spessartite (manganese garnet). — (*Amer. journ. sc.*, May, 1883.) S. L. P. [338

METEOROLOGY.

Thunder-storms.—A special investigation of thunder-storms has been made in Bavaria and Würtemburg since 1879. In 1882, in Bavaria there were 252 stations, which number, distributed uniformly, would give a mean distance between stations of about ten miles. To each of these stations, cards were sent, having questions calling for the time of beginning and ending of thunder, hail, or rain; also, the direction from which the storm came, and the direction and force of the wind.

These investigations show: 1°. That the thunder-storm, while not an accompaniment of a cyclone, still appears with smaller secondary depressions, or spurs of great depressions, which are so flat that they do not produce any strong wind. Of special force is the thunder-storm in the ridge of high pressure dividing two great depression-regions from each other. 2°. That the line upon which simultaneous electric discharges take place encloses a space which has, in most cases, great length but little width, and which stands at right angles to the line of progress of the storm. Such simultaneous discharges have been observed over a region 300 km. (186 miles) broad and about 40 km. (25 miles) deep. 3°. That special regions for thunder-storms are marshy low grounds between the Mediterranean or other smaller bodies of water, and the Alps; also the western declivity of the Bohemian forest. 4°. That in cases where the origin of the storm can be well determined, within the region of observation, it is found that electric discharges take their beginning along a long line simultaneously; and it is conjectured, that the disturbance of the electric equilibrium, by the first discharge, propagates its influence from cloud to cloud, and causes simultaneous outbursts in different places. 5°. Heat-lightning is due to the presence of a storm at a great distance. In one instance it was traced to a storm 270 km. (167 miles) distant. 6°. Arranging the storms according to their frequency at each hour of the day, we find the hours from midnight to eight A. M. of little activity, a very rapid rise from eight A. M. to four P. M., and nearly as rapid a fall to midnight.

The above results show the importance of a detailed observance of these meteors. It is hardly probable that we can learn particulars of these so-called local storms, by observing them at stations a hundred or more miles apart. The various state weather-services have an excellent opportunity for undertaking such observations. It may be possible to learn the movements of these storms over large areas, and thus to

give warning of their approach three or even four hours in advance. — (*Zeitschr. met.*, June.) H. A. H. [339

GEOGRAPHY.

Bureau of commercial science. — The Ministry of commerce in France has just instituted a new bureau, which is to be directed by M. Renard, formerly librarian of the Ministry of marine. This bureau is intended to bring together the publications, letters, travels, and information bearing on commerce, industry in foreign countries, navigation, etc., which come to the authorities in various ways, and selections and translations of documents from foreign sources and collections. Those considered of importance will be printed for the public use. — (*Soc. de géogr. Paris*, June.) W. H. D. [340

Notes on population. — The late census of Monaco shows the principality to contain 9.108 inhabitants, of which more than one-third are French. —— Born Parisians are always in a minority in that city, numbering, according to the latest figures, about thirty-two per cent of the population. The city contains 164,038 foreigners, of which, in round numbers, 45,000 are Belgians, 31,200 Germans, 21,600 Italians, 21,000 Swiss, 10,800 English, 9,250 Dutch, and about 5,000 each, Americans, Russians, and Austrians. Twenty per cent of the total increase of the population of Paris during the years 1876–81 is due to the increase of resident foreigners. —— The stagnation of the population of France is exciting much attention, and even apprehension. It is sufficiently evinced by its proportional ratio to the Anglo-Germanic population of Europe. This in 1700 was three to three, or fifty per cent; that is to say, France equalled in population the whole of the group referred to. In 1881, however, her ratio was as three to seventeen; or, if the Anglo-Germans of the United States be counted in, it was only three to thirty, or about ten per cent. —— The population native to the Marquesas Islands in 1855 was about 12,000: at present it has diminished to 5,700. —— The population of Tunis, it seems, has been greatly exaggerated. Instead of five or even two and a half million, as has been accepted for some years, the late investigations of M. Perpetue show that the total figure, probably, should not exceed 1,400,000, of which about 36,000 are foreigners. — (*Bull. soc. géogr. Mars.*, June.) W. H. D. [341

(North America.)

Fisheries of British Columbia. — Foreign vessels have been officially warned from taking or curing fish within three miles of the coast of the province. The value of the catch for 1882 was $1,842,675, and of vessels, nets, etc., $229,600. Twenty canneries and other land-stations are assessed at $402,000. They employed, in 1882, 5,215 hands and 79 vessels; and the increase in value, over 1881, of the product, was over thirty per cent. More than twelve million cans of salmon and nearly six hundred thousand pounds of herring were put up during the season. — W. H. D. [342

Salmon-fisheries in the north-west. — The output of canned salmon on the Columbia River, at the close of the season, was 629,438 cases, and the disbursements to the fishermen employed were $1,550,000. In 1882, 541,300 cases were put up on the Columbia. About 17,500 cases had been put up on the Fraser River to Aug. 1; but, for the complete returns, details for this and the Alaskan region are not yet received. The total pack on all rivers on the north-west coast of America, in 1882, was 941,187 cases, each containing the equivalent of forty-eight pounds of canned fish, or at least double that amount of fresh fish, equal to about five million individual salmon of ten pounds each. — W. H. D. [343

(South America.)

Notes. — C. de Amezaga, in the Bulletin of the Italian geographical society, gives a general description of the Galapagos, with a map, from investigations by Wolf and Icaza, and an historical account of them, and the endeavors to colonize them. It appears that there is actually a small settlement on Chatham Island of recent date. Older ones on Floriana all came to an unfortunate termination. —— The Instituto Argentino meditates an expedition to southern Patagonia, to be directed by Capt. Carlo Moyano, who lately crossed the Patagonian desert from Santa Cruz to Port Deseado. —— The death of Bartolomeo Lucioli is reported on the 9th of June, while on his way from Lisbon to Para. The deceased, who was about fifty years of age, had been a civil and military officer in the Peruvian service, but was afterward more distinguished as an explorer of the Ucayali and upper Amazons, and as the collector of a precious ethnological exhibit now in the Ethnological museum at Rome, relating to the inhabitants of this region. —— The commission for determining the boundary between Venezuela and Brazil, in the vicinity of the Orinoco, has returned to Rio Janeiro. They bring valuable geographical material, but have suffered severely from fever and other evils attendant on such explorations in South America. —— Lovisato, one of Bove's companions, has read a paper before the Italian geographical society on his geological researches in Patagonia and Tierra del Fuego, describing the glaciers of the latter region, and suggesting reasons for the supposition that the antarctic region is occupied by land rather than sea. —— Some notes on New Grenada, made in 1617–30 by Hubert Verdonck, a Belgian Jesuit, appear in the Anvers Bulletin. They contain a few ethnological and historical details of interest; but even at that time the aborigines had totally disappeared from the vicinity of Carthagena and Panama. —— A letter from the French meteorological station at Orange Harbor, in the *Revue géographique* for July, while containing no information of importance, is accompanied by two characteristic illustrations of Fuegian people, and one of their dogs. — W. H. D. [344

BOTANY.

Sylloge fungorum. — The second volume by Prof. P. A. Saccardo, of more than eight hundred pages, includes all the remaining species of Pyre-

nomycetes not treated in the first volume, together with an index of all the genera and species of the order. There are also several pages of addenda to both volumes, including the species published up to a very recent date. In fulness and general arrangement, the present volume has the same merits as its predecessor. Vol. iii. is announced to appear in 1884, and will include the Sphaeropsoideae, Melanconieae, and Hyphomycetes. — W. G. F. [345

Illustrations of British fungi. — This comprehensive and finely executed work by M. C. Cooke has now reached the end of the second volume, including eighteen parts and an index. The two volumes already issued include figures of all the leucosporic species of Agaricus known to occur in Britain, except twenty-six little-known species, three hundred and seventy-eight species with varieties being represented — a considerably larger number than is included in the works of Sowerby, Bulliard, or Krombholz. The work will be continued, and contain plates of the remaining sections of Agaricus. — W. G. F. [346

Ascospores in the genus Saccharomyces. — In the reports of the Carlsberg laboratory, Hansen gives a *résumé* of his researches on the formation of ascospores in the different forms of Saccharomyces. While in general he agrees with Rees's views, he denies the possibility of distinguishing species of Saccharomyces by the ascospores; and, in fact, he is hardly inclined to admit the specific value of the different forms described by Rees. Hansen's experiments were made with cultures of single spores obtained by a process of dilution, which he describes in detail; and the purity of the cultures was recognized by the formation, on the walls of the culture-flasks, of a single spot formed from the growth of one spore. He also adopted, with good results, Koch's method of gelatine culture. While the ascospores of the different so-called species of Saccharomyces cannot be distinguished by their shape, Hansen found that there was a difference in the time of their germination when exposed to different temperatures; and he gives a series of curves to represent the results of his experiments with regard to the temperature in six different forms. The curves all have a similar form; but the maxima and minima vary with the different species, the minimum being between ½° C. and 3° C., and the maximum about 37½° C. There follows a discussion of what Pasteur calls Torulae, which resemble species of Saccharomyces, but are separated from that genus by Hansen, because he found that they did not produce ascospores. The paper concludes with an account of diseases of beer caused by certain alcoholic ferments. — W. G. F. [347

ZOÖLOGY.

Worms.

Homology of the nemertean proboscis and the chorda dorsalis. — In an article on the ancestral form of the chordata, Hubrecht defends the following speculative thesis: "According to my opinion, the proboscis of the nemerteans, which arises as an invaginable structure (entirely derived, both phylo- and onto-genetically, from the epiblast), and which passes through a part of the cerebral ganglion, is homologous with the rudimentary organ, which is found in the whole series of vertebrates without exception, — the hypophysis cerebri. The proboscidean sheath is comparable in situation (and development ?) with the chorda dorsalis of vertebrates." Without adding new facts, but merely basing his arguments on what is already known, the author defends his hypothesis with great ingenuity. His chief argument is, that the proboscis and the hypophysis are both anterior ectodermal invaginations, and are homologous. His use of terms is misleading. By 'proboscis' he designates apparently both the free portion of the proboscis and its sheath; by 'proboscidean sheath,' on the contrary, the posterior portion of the proboscis, which has no sheath, and is not free. At least, his descriptions became intelligible to the reporter only on that assumption. The posterior unfree part of the proboscis he considers the homologue of the notochord. The vertebrates are not connected with the annelids; but, on the contrary, the two lateral nerves of lower worms have united *dorsally* to make the central nervous system of vertebrates, *ventrally* to form the ganglionic chain of annelids and their derivatives. In the second half of his paper, the author endeavors to strengthen his position by comparisons between other organs in nemerteans and vertebrates. [It is possible that Hubrecht's hypothesis will be verified; but the objections to it come to mind so immediately, and in such throngs, that it is difficult to believe the hypothesis well founded. Some of the most serious objections are ably presented by Whitman in an article accidentally published in the same number (p. 376), and arguing in favor of the annelidan affinities of vertebrates.] — (*Quart. journ. micr. sc.*, xxiii. 349.) C. S. M. [348

Embryology of Planaria polychroa. — Metschnikoff has studied the development of fresh-water planarians, and reached conclusions that are, in part, very startling. Pl. polychroa lays its egg-capsules in late spring and early summer. Each capsule contains from four to six eggs, and thousands of the so-called 'yolk-cells.' The egg has no membrane. The yolk-cells immediately around each ovum break down, their membranes disappear; but their nuclei remain for a long time distinguishable, although they finally disappear in the embryo, into the composition of which these disintegrated cells enter. The ovum segments, but the cleavage-cells do not cohere, there being no vitelline membrane: on the contrary, each embeds itself in the mass derived from the yolk-cells. In some manner, which is left in complete obscurity by the author's descriptions, the cells from the ovum gradually spread themselves, and form first the pharynx, and then an epidermal layer of thin cells, which encloses the whole of the disintegrated yolk-mass, together with cells from the ovum, embedded in it. In the centre of this mixed parenchym appears a cavity which communicates with the lumen of the pharynx. This last seizes and swallows the surrounding yolk-cells, each intact. The cells scattered through the body form the mesoderm (mes-

enchym), which arranges itself so as to form the partitions of the body, dividing the disintegrated yolk-mass into separate accumulations, which, combining with the yolk-cells swallowed, gradually assume the form of the intestine with its coeca. No entoderm exists, unless two cells at the base of the proboscis are a remnant of it. During these changes the nervous system appears, and the sheath around the proboscis is developed. Metschnikoff advances the opinion, that the yolk-cells swallowed, though not derived from the ovum, and being foreign bodies, nevertheless become the cells of the apparent entoderm of the adult. He further believes that the nervous system is derived from the mesoderm. If Metschnikoff is correct in maintaining, that, *first*, there are no epithelial germ-layers; *second*, the cleavage-cells are mixed with and embedded in a foreign substance; *third*, foreign cells form the entoderm, there being no embryonic entoderm; *fourth*, the nervous system is derived from the mesoderm, — then it is obvious that the general conclusions which we are wont to consider to have been well established by embryological research are erroneous, although they rest upon a vast body of evidence. One would suppose that no attempt to set this evidence aside would be made, except after the most unquestionable determination of new facts. Now, Metschnikoff's researches leave every one of the processes involved in his novel views in absolute darkness; for he has not, for the most part, observed them at all. His surprising deductions are based upon a failure to ascertain what are the actual processes, and seem to the reporter invalid. The value of the real observations is, of course, unaffected by the speculative portions of the essay. — (*Zeitsch. wiss. zool.*, xxxviii. 331.) C. S. M. [349

Insects.

Epidermal glands of caterpillars and Malachius. — The following are the principal results obtained by Stan. Klemensiewicz. 1°. The eighth and ninth segments of the larvae of Liparis, Leucoma, Orgyia, and Porthesia auriflua, have each a little protuberance on the median dorsal line, with the opening of a gland at the summit. The secretion is clear and odorless. The skin is invaginated at the top of the papilla to form a pendent sack, at the base of which are inserted two muscles running obliquely backwards; and there also open two glands by a common duct. The external surface of the glands is smooth, but in their interior each gland-cell forms a separate bulging mass: the appearance thus presented is singular. The lumen of the duct is very small; its thick walls are formed by two large cells, much like those of the gland proper. In Leucoma salicis there are quite similar glands on the fourth and fifth segments. 2°. The exsertile horns of Papilio Machaon, larva, are described. They are really developments of the tegument: the epidermal cells of their walls are large, and contain numerous rod-shaped bodies; but the cells at the base of the horns are much smaller, and glandular (their secretion being probably discharged through pores of the adjacent cuticula). It may be assumed, that the odorous secretion accumulates in the invaginated horns, and is freed by their exsertion. 3°. The caterpillar of Harpyia vinula has a gland in the first segment, opening ventrally. The gland is flask-shaped, the neck acting as duct, and opening into a large transverse fissure; the body of the flask is the gland proper, and is lined by polygonal epithelial cells, with irregularly shaped nuclei; the epithelium rests upon a thin tunica propria. 4°. A similar organ to the last mentioned was described in Vanessa larvae, by Rogenhofer (*Verh. zool.-bot. ges. Wien*, xii. 1227): it is an invagination of the skin on the ventral side of the first segment; its cuticula is thin, and forms numerous little cups, under each of which is a thin epithelial cell. 5°. The orange-colored fleshy warts on the sides of the thorax and abdomen of Malachius are also glandular. The epidermis presents no special features in the warts, except that it bears scattered unicellular glands of the form typical for insects; they are flask-shaped, with a coiled cuticular duct in their interior, the duct being continuous with a pore-canal through the general cuticula of the wart. In the lower and larger end of each cell, lies the round nucleus. — (*Verh. zool.-bot. ges. Wien*, xxxii. 459.) C. S. M. [350

ANTHROPOLOGY.

Prehistoric copper. — Professor J. D. Butler confidently asserts that the Wisconsin state historical society's collection contains more American aboriginal copper implements than he has been able to hear of in all other cabinets whatever. One axe weighs four pounds twelve ounces and a quarter, and is the heaviest article of wrought copper as yet brought to light. Fourteen new implements have lately been added, some of them unique in form, or size, or in the location from which they were derived. More than fifty coppers have come to the cabinet from Washington county alone. This fact is doubtless due to Mr. Perkins's persistent search in that locality. — (*Wisc. hist. coll.*, ix. 97.) J. W. P. [351

Aztalan. — The largest and most elaborate aboriginal monument in Wisconsin is Aztalan, fifty miles east of Madison. It was first discovered by Timothy Johnson in 1836, and described by Nathaniel F. Hyer in the *Milwaukee advertiser*, January, 1837. Mr. Stephen Taylor gave an illustrated account of it in *Silliman's journal* in 1843; and the place was first accurately surveyed and plotted by Dr. Lapham, in 1850, whose description and drawings were published in 1855, in the Smithsonian contributions to knowledge. "This strange monument," says Prof. Butler, "was styled Aztalan by Mr. Hyer, inasmuch as it seemed to him a structure worthy of the Aztecs." Upon this point Mr. Peet says, "The name Aztalan was derived from a tradition, which was said to be common among the Indians, that a people partially civilized built here a city, and a hundred years afterward, becoming dissatisfied, proceeded south to Mexico." There is no reason to suppose that the Aztecs, or any other Mexican people, were in any way connected with it. Much curiosity has been excited with reference to the Aztalan bricks, which are shapeless

clods of clay, burnt red and pretty hard. The process of burning is supposed to have been similar to that discovered by Schliemann at Troy. The soil, a sort of loam, had been thrown up into a rampart, the whole coated with clay matted together with bushes and sedge. Over all were heaped prairie-grass and trees, and the pile set on fire. Dr. Yarrow describes a like process pursued in North Carolina grave-mounds. — (*Wisc. hist. coll.*, ix. 99.) J. W. P. [352

EARLY INSTITUTIONS.

History of agricultural prices in England. — M. Jusserand reviews Mr. Thorold Rogers's work upon this subject. He pronounces it one of the great books of our century, and indispensable to the student of economic history. It is full of facts hitherto unknown, or, if known, unclassified, and inaccessible to most students. Mr. Rogers's opinion that the fifteenth century, and the beginning of the sixteenth, was a golden age for the laboring-people of England, is cited as especially notable, inasmuch as a contrary opinion has generally obtained up to this time. — (*Rev. critique*, 18 juin, 1883.) D. W. R. [353

Indirect taxation among the Romans. — M. Dareste sums up all, or nearly all, that is known upon this subject. Very little is known; and very little is likely to be known, unless some more inscriptions, like that discovered not long ago in the ruins of Palmyra, should be found. It was an important find, — a custom-house tariff with regulations regarding the collection of duties. (See *Bull. corresp. hellén.*, mai–juin, 1882.) The inscription has not yet been published. The principal indirect taxes of the Romans were, the custom-house duty (portorium), a tax on successions, upon the manumission of slaves, and the sale of movable goods. They were not very heavy taxes at any time. M. Dareste gives us a very good account of the portorium. The Roman custom-houses were scattered about here and there, wherever merchants were wont to pass or to congregate. A list of localities where there were custom-houses is given. The portorium was a percentage levied upon the value of merchandise. Only merchandise was subject to it. Personal effects of travellers, *instrumenta itineris*, etc., were free of duty. A list of writings upon the subject is given. The principal work cited is that of M. R. Cagnat: *Étude historique sur les impôts indirects chez les Romains.* It was written before the discovery of the Palmyra inscription. — (*Séances trav. acad. inscr.*, Feb.–March, 1883.) D. W. R. [354

INTELLIGENCE FROM AMERICAN SCIENTIFIC STATIONS.

GOVERNMENT ORGANIZATIONS.

Geological survey.

Field-work of the division of the Great Basin. — In consequence of the extension of the work of the survey to the Atlantic states, the director has found it necessary to divert some of its force from investigations already initiated. One of the most important researches thus stopped is that of the quaternary lakes of the Great Basin. The corps was reduced at the beginning of the fiscal year, and instructed to devote the field season to supplementing the material already acquired, so as to prepare it for publication without future visits to the district.

The office at Salt-Lake City was closed on the 30th of June, and field operations were immediately begun. Mr. I. C. Russell, assistant geologist, proceeded to Mono valley, California, and carried to completion his examination of the existing lake and its ancient expansion. He included in his study, also, the six extinct glaciers which anciently debouched in the Mono valley, tracing them to their common source in the great névé of the Sierra Nevada. Incidentally he examined the ice-masses associated with some of the summits of the Sierra, and brought the camera to bear on them. These have been called glaciers by Muir and others, but are said by King to be unworthy of the name; and it may be hoped that these later observations and illustrations will suffice to place the matter beyond controversy.

From the Mono basin he proceeded to the Walker, Carson, Pyramid, Winnemucca, and Black Rock basins, for the purpose of re-investigating certain points connected with the history of the ancient Lake Lahontan, upon which he is preparing a report.

Mr. W. D. Johnson, topographer of the division, spent the summer, under Mr. Russell's direction, in surveys for a general map of the Mono basin, and is now engaged on a series of special maps of ancient glacial moraines.

Ensign J. B. Bernadou, detailed from the navy for the purpose, has acted during the summer as Mr. Russell's assistant.

Mr. G. K. Gilbert, who has general charge of the work, spent a few weeks in the field, visiting localities of special interest in the Lahontan, Bonneville, and Mono basins. He was accompanied in the Lahontan basin by Mr. R. Ellsworth Call, the conchologist, who is engaged in a study of the molluscan faunas of the quaternary lakes of the Great Basin, and took the field for the purpose of familiarizing himself with their geological relations.

The Champlain valley. — Mr. Charles D. Walcott, with Mr. C. Curtice as assistant, has been studying the formations between the archean and Trenton in Saratoga county, N.Y., and along up the Champlain valley on both sides of the lake.

Saratoga village, west of the fault-line along which the springs occur, was found to be built over a massive, gray, magnesian limestone, that carries a strongly marked fauna closely allied to that of the Potsdam sandstone of Wisconsin. The geologic section from

the archean to the base of the bird's-eye limestone was found to be of great interest. At Glen Falls, Essex, Ausable Chasm, and Chazy, N.Y., sections were taken, and collections formed.

The sections taken at Highgate Springs, Swanton, St. Alban's, and Georgia, Vt., by Professor Jules Marcou, were critically examined, and large collections of fossils secured. The data obtained show the dip of the Winooski marble series and the slates above, carrying the Olenellus fauna, to be the same. The five hundred feet of magnesian limestone, with its interbedded arenaceous layers, conformably underlie the Olenellus beds. The fauna at the Georgia locality was increased by the addition of eight species not before reported as occurring there.

NOTES AND NEWS.

MR. H. M. STANLEY contributes to the *New-Englander* an interesting, and, on the whole, clearly written study, entitled 'Evolution as bearing on method in teleology.' The essay follows a train of thought somewhat similar to the one stated in a book that appears almost at the same time, and that we reviewed recently; viz., Mr. Hicks's Critique of design arguments. Mr. Stanley is thankful to the doctrine of evolution for having rid teleology of a useless and somewhat dangerous argument, — the argument from mere ignorance; i.e., from our incapacity to explain certain singular or wonderful things save by supposing a powerful being directly working to produce them. This argument, which covers, on the whole, much the same ground as is covered by what Mr. Hicks calls teleology in the narrower sense, is regarded by Mr. Stanley as superseded by the doctrine of evolution. We now see that nature ought to be regarded as a 'practically infinite series of second causes;' so that, if we are now ignorant of the cause of any phenomenon, we still have a right to expect to find for it hereafter a purely natural cause. Every thing has grown; and we have to view nature as a vast and perfect machine, self-supplying, self-regulating, and not needing any workman to stand by to watch the steam-gauge, to put in the material, or to oil the bearings. Yet this view is not atheistic, according to Mr. Stanley; for the supposition of a designing intelligence remains, only this intelligence is 'immanently behind phenomena.' By this being, all things consist. In fact, the more nearly automatic the machine, the more perfect the contriving intelligence. "If an automatic locomotive-machine is a sign of very great intelligence, how much greater intelligence would an automatic universe-machine exhibit? . . . Teleology has been called a 'carpenter theory,' but a teleology which views the universe as a practically infinite automatic machine would forever destroy the force of any such epithet." In other words, as we understand Mr. Stanley, a 'practically infinite' carpenter would be something much better than a carpenter; and teleology gains rather than loses when the doctrine of evolution shows that the carpenter's tinkering of his work, if there is any tinkering, is practically infinitesimal. All this seems to us not at all novel; but, for the most part, it is very well put, and worth saying.

But when we inquire of any of these evolutionary design arguments, not how they defend themselves against the charge of atheism, but how they demonstrate theism, we are disappointed. Mr. Hicks, as we saw in reviewing him, is very definite on this point as to what he attempts, and as to what he does not attempt; but his definiteness only serves to show his weakness. He declares that order, as such, is proof of intelligence, but adds that the proof is solely inductive. Men are orderly because they are intelligent: hence nature, if orderly, must be somehow associated with intelligence. We answered this induction by asking whether all brilliantly colored odjects must needs be visited by insects merely because the colors of flowers depend upon *their* relations to the habits of insects. But with Mr. Stanley we hardly have room for so definite a criticism; for, though his argument in favor of theism, in so far as he suggests one at all, seems to be inductive, it seems also most carefully to shun any such definite statement as should make it definitely answerable. The vast machine needs, it would seem, a controlling intelligence, which does not interfere with it, and yet does somehow direct it. The 'practically infinite series of second causes' is not enough by itself, and we must somehow get outside of it to find a designer; and, when we ask how the designer is related to the series of second causes, we get the charmingly innocent answer, that he is 'immanently behind phenomena,' — an expression that seems to us either mere words, or else an excellent Irish bull. Perhaps Mr. Stanley can explain this phrase for us; but meanwhile, as one casts about for an interpretation, one is reminded strongly of Brer Fox, in the wonderful tar-baby story, as he 'lay low' in the bushes, watching his creation the tar-baby while it slowly intrapped Brer Rabbit. Possibly Brer Fox was 'immanently behind' that tar-baby. But our criticism is only of bad arguments and of obscure expressions, not of the view itself that the order of the universe implies an intelligence. The latter we hold as positively as Mr. Hicks or Mr. Stanley, only we insist that the question is not in the least one of inductive science. The 'design' argument in all its accustomed forms is bad, because it is an inductive argument, applied as true empirical science never applies any inductive arguments; viz., to matters wholly beyond the limits of phenomenal existence. The whole question is one of philosophy. Not as a result of induction, but as an implied premise of the inductive, or of some other rational thinking process, must this doctrine of intelligence in nature be established, if at all; and therefore only a critical philosophy, that examines the assumptions lying at the basis of the thinking processes, has any business with the question. Empirical science, as such, has simply once for all 'no need of that hypothesis.'

— A fire broke out last week in the cellar of the building containing the geological collections at Amherst college. Fortunately it was discovered early, and put out by the students before any serious damage

was done. It will be recollected that the college lost the fine mineralogical cabinet of Prof. C. M. Shepard last year by fire; and the fear of a repetition of that disaster caused a too hasty removal of many objects from the lower floor, labels and specimens becoming sadly mixed. The wind was very high; and, had the fire gained greater headway, nothing could have saved the museum, or the observatory attached.

— Charles Leslie McKay of the U.S. signal-service, stationed at Nushegak, Alaska, was drowned in Bristol Bay last April, while engaged in collecting fishes for the U.S. national museum. Mr. McKay had done considerable work in ichthyology, his most important publication being a 'Review of the Centrarchidae,' in the Proceedings of the U. S. national museum for 1881.

— At its meeting, Oct. 27, the Philosophical society of Washington listened to a communication by Dr. T. N. Gill on the ichthyological results of the voyage of the Albatross, and to one by Prof. A. Graham Bell on fallacies concerning the deaf. Dr. Gill described two anomalous fishes, one of which required the institution of a new order. Professor Bell's paper was the subject of a lively debate.

— Those who have followed the discussions in SCIENCE on the St. David's rocks will be interested in a new phase of the controversy, introduced by a paper before the British association by Prof. J. F. Blake. The rocks below the Cambrian conglomerate have been described by Dr. Hicks as bedded rocks belonging to three distinct periods. The same rocks have been recently asserted by Dr. Geikie to be partly Cambrian, and partly intrusive. Professor Blake contends that they are pre-Cambrian in age, but form a very complete volcanic series, which may well be designated the Dimetian. The basis of the series is the Dimetian granite, serving as the core. This is surrounded by the more acid rocks, as the quartz felsites and the felspar porphyries (the so-called Arvonian); and the more outlying portions consist of very varying materials, chiefly rough ashes or agglomerate breccias, — on the east side finely-bedded 'halleflintas,' and on the north side many basic lava-flows. These are the so-called 'Pebidian.' The arrangement of these rocks shows the characteristic irregularity of volcanic rocks; and, though many portions are bedded, they have no dominant strike over the whole district. The Cambrian series, commencing with the conglomerates, is quite independent, and hangs together as a whole. In no case can a continuous passage be proved from the one series to the other: the junction is in most cases a faulted one; and, at the places where this is not so, the conglomerate lies on different beds of the volcanic series.

—At the meeting of the Boston society of natural history, Nov. 7, Prof. H. W. Haynes spoke of the agricultural implements of the New-England Indians, Prof. W. O. Crosby read a paper on the origin and relations of continents and ocean-basins, and Dr. M. E. Wadsworth gave brief notes on the lithology of the island of Jura, Scotland.

— Mr. George Shoemaker, a very industrious and promising young naturalist connected with the National museum, died in Washington on the 12th of October.

— Herr Jacobson, who has spent four years on the north-west coast of America in making ethnological collections for the Berlin museum, has recently returned, and will sail for Europe.

— Dr. Leonhard Stejneger has arrived in San Francisco, *en route* for Washington. He has spent a year in Bering Island in the study of its fauna, and in collecting remains of the extinct arctic sea-cow.

— The Hydrographic office has published a monograph (no. 4.), by Lieut. Southerland, upon the two August hurricanes. It contains abstracts from the logs of forty vessels which were near the path of one or both of these storms, a chart of the course of each storm, a diagram of the tracks of two barques which were near the path of the second hurricane, and sailing-directions for managing vessels when near similar dangerous cyclones. The projected paths resemble those previously published by the signal-office in the Weather review for August (SCIENCE, no. 37), but differ somewhat in detail. The latter were based upon the reports of more vessels than those enumerated by Lieut. Southerland. Some of the ships mentioned are common to the two reports; but doubtless a more accurate representation of the paths of the hurricanes could have been obtained, had all the data been combined in one report.

— Mr. J. B. Fell, C E., gave a paper on the construction and working of alpine railways, at the recent meeting of the British association, which is thus reported in *Nature*. There are three alpine railways in existence at the present time, — the Mont Cenis and St. Gothard railways, which have been made with long summit tunnels, and with ordinary gradients; and the Brenner railway, that has been made with similar gradients, but without a long tunnel. The important question has now arisen, and has been taken into serious consideration by the governments and local authorities interested, as to how far it may be possible to make other trans-alpine railways, some of which are urgently needed, at a cost that would render them financially practicable; and, to accomplish this object, it has been proposed to effect a reduction of one-half or more of the cost, by carrying these railways over the mountain-passes by means of steep gradients and the use of the centre rail system, as it was adopted on the Mont Cenis railway. Upon these improved summit railways the same weight and number of trains could be run that are now running on the Mont Cenis tunnel railway; and, with the protection of avalanche galleries and covered ways, the regularity of the service would be maintained at all seasons of the year. The extra cost of working-expenses caused by working over a higher level than that of a tunnel line would, if capitalized and added to the cost of construction, still leave a clear net saving of more than one-half in the cost of construction, as compared with the cost of a tunnel railway. The result of the experiences of the last twenty-five years seems to point to the conclusion that a method of constructing alpine railways with long, non-paying tunnels, is a thing of the past. The future belongs

to the best system that can be devised for overcoming the difficulties of trans-alpine railways rather by adding to the powers of the locomotive-engine, and by other mechanical appliances for reducing the cost of traction on steep inclines, which methods are capable of indefinite improvement, than by burying in gigantic tunnels enormous sums of unproductive capital, that, when once expended, are irrecoverably lost.

— We learn from *Nature* that the electric railway from Portrush to the Giant's Causeway was opened Sept. 28 by Earl Spencer; and among others present, were Sir William Thomson, Sir William Siemens, and Sir Frederick Bramwell. It is over six miles long, and has cost £45,000. The line, after passing through the principal street of Portrush, follows the seaside road, a portion of a footpath six feet broad being reserved for the railway. The gauge is only three feet; and the gradients are very steep, — in places as much as one in thirty-five; and in parts of its course the curves are sharper than might have been desirable had the route which it takes been chosen by the engineers. The force to work it is generated by a waterfall in the river Bush, with an available head of twenty-four feet, the electric current being conveyed by an underground cable to the end of the tramway. The water-power passing through turbine water-wheels, which utilize the whole force of the fall, is said to amount to ninety horse.

— At the meeting of the Engineers' club of Philadelphia, Oct. 20, Mr. John Haug exhibited and described very complete sets of drawings for two vessels designed by him, — the one a tug-boat for the Philadelphia board of health, and the other a barge for the transportation of freight and passenger cars. Mr. J. H. Harden read a paper, prepared for publication as part of the Report of the second geological survey of Pennsylvania, relating to the "Early mining operations in Berks and Chester counties, including the present condition of the Jones mine." Prof. L. M. Haupt presented notes on conventional colors for drawing.

— Before the Biological society of Washington, at its meeting, Nov. 2, the communications were: Dr. George M. Sternberg, U.S.A., Micrococci; Dr. E. M. Schaeffer, Further remarks on manna, with exhibition of specimens; Dr. T. H. Bean, Arrested asymmetry in a flounder, with exhibition of specimens; Professor Lester F. Ward, Mesozoic dicotyledons.

— The autumn meeting of the Society of mechanical engineers, which has just closed in New York, has been unusually well attended, and some important lines of discussion have been drawn out. Considerable interest was shown in the proposed re-appointment of a board to supervise the work with the Watertown testing-machine.

— The Massachusetts agricultural experiment-station at the Agricultural college in Amherst, Mass., was established by an act of the legislature approved on the 12th of May, 1882. Its management is vested in a board of control, consisting of the governor of the state, two members of the state board of agriculture, two members of the board of trustees of the Massachusetts agricultural college, one member of the Massachusetts society for promoting agriculture, and the president of the Massachusetts agricultural college. The present officers of the station are all members of the college faculty, and are Prof. C. A. Goessmann, director and chemist; Prof. M. Miles, superintendent of field and stock experiments; and Prof. S. T. Maynard, superintendent of horticultural experiments, microscopist, and draughtsman. The station proposes to publish monthly bulletins, of which two have already appeared. The first contains an account of the organization of the station, and a general statement of its purposes, and also analyses of ten samples of fodders. The second and third bulletins contain analyses of four samples of fodders and of fifty-six of fertilizers and fertilizing materials.

— An extended review of the results of the German census of 1881 is given by Ch. Grad in the *Revue scientifique*, 1883, 109.

RECENT BOOKS AND PAMPHLETS.

Bachmann, O. Unsere modernen mikroskope und deren sämmtliche hilfs- und neben-apparate für wissenschaftliche forschungen. München, *Oldenburg*, 1883. 15+344 p., illustr. 8°.

Burr, W. H. The elasticity and resistance of the materials of engineering. New York, *Wiley*, 1883. 15+753 p. 8°.

Campagne, E. Les météores. Rouen, *Mégard*, 1883. 189 p., illustr. 8°.

Denza, F. La meteorologia e le sue più recenti applicazioni. Torino, *Speirani*, 1883. 364 p. 8°.

Fallet, C. Les mers polaires. Rouen, *Mégard*, 1883. 160 p., illustr. 8°.

Gérardin, L. Les bêtes, éléments de zoologie théorique et appliquée. Paris, *Masson*, 1883. 2+418 p., illustr. 18°.

Landolt, H., and **Börnstein,** R. Physikalisch-chemische tabellen. Berlin, *Springer*, 1883. 12+249 p. 8°.

MacCord, C. W. Kinematics: a treatise on the modification of motion, as affected by the forms and modes of connection of the moving parts of machines; illustrated by diagrams of mechanical movements, as practically constructed; for the use of draughtsmen, machinists, and students of mechanical engineering. New York, *Wiley*, 1883. 9+335 p. 8°.

Malte-Brun. Lectures géographiques: l'Europe, description générale. Limoges, *Barbou*, 1883. 141 p. 12°.

Ollivier-Beauregard. En Asie, Kachmir et Tibet, étude d'ethnographie ancienne et moderne. Paris, *Maisonneuve*, 1883. 144 p. 8°.

Petit, H. Notes sur l'habitat des coléoptères de France. Châlons-sur-Marne, *Martin*, 1883. 66 p. 8°.

Physik, die, im dienste der wissenschaft, der kunst und des praktischen lebens. Red. G. Krebs, unter mitwirkung von J. van Bebber, C. Grahwinkel, E. Hartwig. lief. i. Stuttgart, *Enke*, 1883. 112 p., illustr. 8°.

Reusch, H. H. Die fossilien führenden krystallinischen schiefer von Bergen in Norwegen. Autorisirte deutsche ausgabe von R. Baldauf. Leipzig, *Engelmann*, 1883. 4+134 p., 92 illustr., map. 8°.

Trautvetter, E. R. Incrementa florae phaenogamae rossicae. fasc. i. Berlin, *Friedländer*, 1882. 4+240 p. 8°.

Tschermak, G. Die mikroskopische beschaffenheit der meteoriten, erläutert durch photographische abbildungen. lief. i. Stuttgart, *Schweizerbart*, 1883. 12 p., 8 pl. 4°.

Van Overbeck de Meijer. Les systèmes d'évacuation des eaux et immondices d'une ville. Paris, *Baillière*, 1883. 143 p. 8°.

Weismann, A. Ueben die ewigkeit des lebens. Freiburg-i.-Br., *Mohr*, 1883. 79 p. 4°.

Weselsky, P., and **Benedikt,** R. Dreizig uebungs-aufgaben als erste anleitung zur quantitativen analyse. Wien, *Treflits & Deuticke*, 1883. 41 p., illustr. 8°.

Weyr, E. Die elemente der projectivischen geometrie. heft i.: Theorie der projectivischen grundgebilde erster stufe und der quadratischen involutionen. Wien, *Braumüller*, 1883. 9+231 p. 8°.

Witthaus, R. A. The medical student's manual of chemistry. New York, *Wood*, 1883. 370 p., illustr. 8°.

Wright, E. P. Animal life. being the natural history of animals. New York, *Cassell*, [1883.] 8+618 p., illustr. 8°.